Periodical

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November
1933

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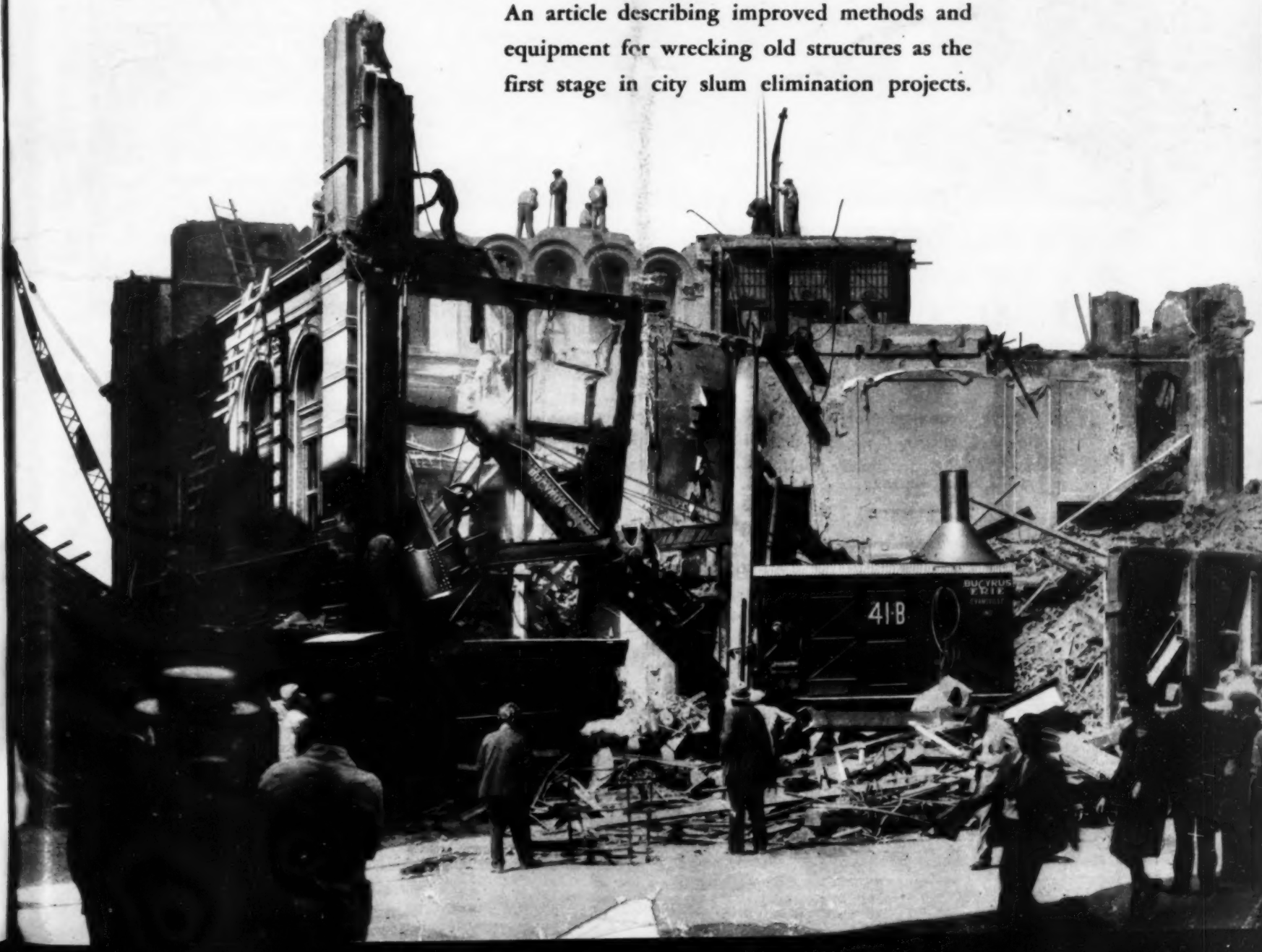
Construction Methods

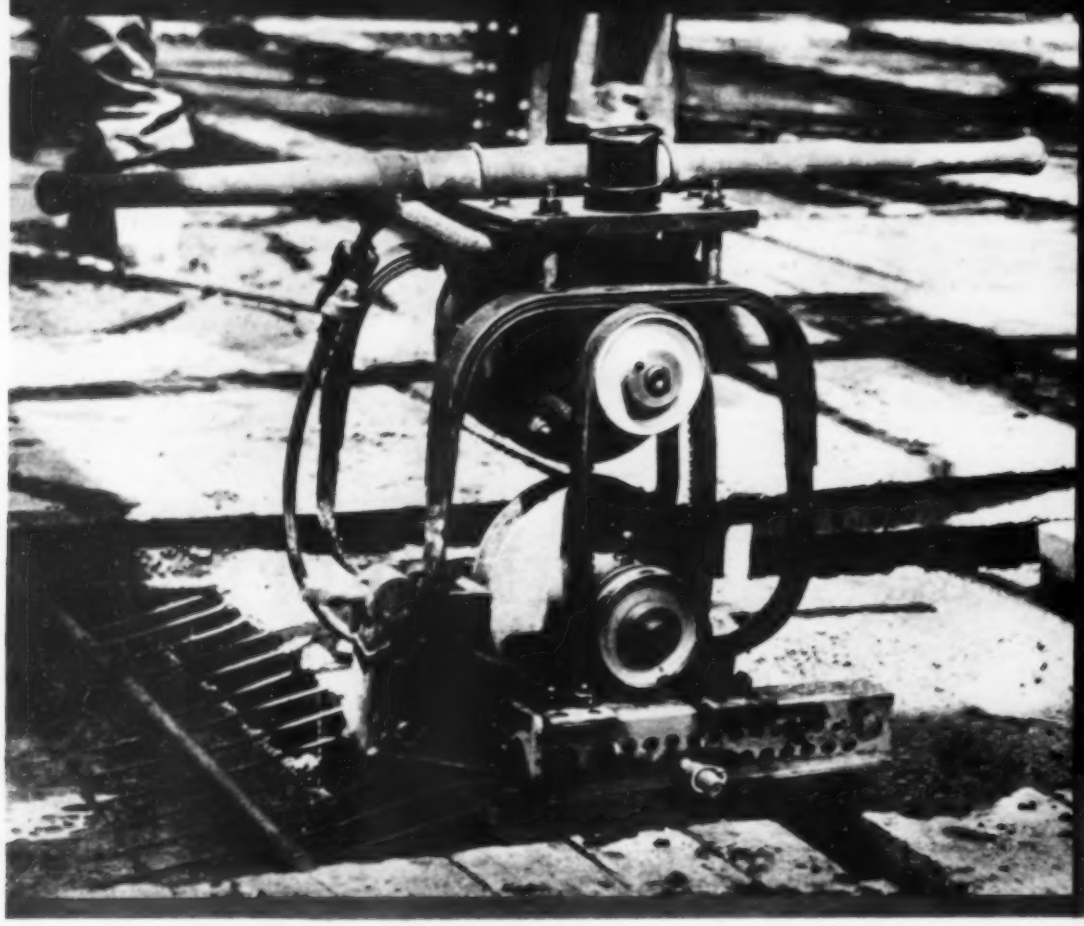
In This Issue:—

The Technique of
BUILDING DEMOLITION

An article describing improved methods and equipment for wrecking old structures as the first stage in city slum elimination projects.



VIBRATE THE STEEL FOR BETTER CONCRETE



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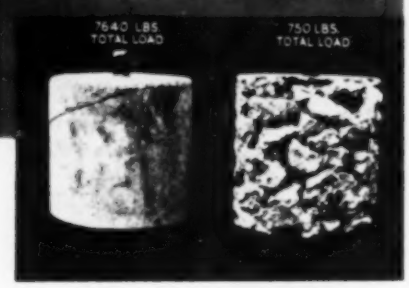

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Construction Methods

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WILLARD CHEVALIER, Publishing Director

To Speed Highway Program

● The recent call of the Public Works Administrator upon governors of all states requesting a speeding up of highway construction programs brought an encouraging response from state executives. In urging the necessity for decreasing the lapse between the approval of road projects and the start of actual construction the Administrator asked the governors to make a check of the road programs in their states and to advise him what steps might be taken to expedite the work. Almost all responses contained the assurance that the states will now press for speed in the awarding of contracts and initiating actual work. Virtually every governor expressed the conviction that his state will have awarded all contracts under the $400,000,000 federal allotment by Jan. 1, with the greater portion of the awards being completed within 30 days.

Quick Action for PWA Funds

● A policy of keeping Public Works Administration's funds from being tied up so that they are not available for furnishing employment within a year was announced last month by Administrator Harold L. Ickes. The policy was formulated when, with more than $2,000,000,000 of the $3,300,000,000 fund already allotted, it became apparent there would be use for all of the unallotted money shortly and none could be permitted to lie idle for use two or three years hence.

The "Merit Clause" for Industrial Codes

● President Roosevelt, in signing the Retail Code last month, made a significant pronouncement sounding the death knell of the so-called "merit clause" proposed for industrial codes in connection with the controversial Section 7(a) of the Recovery Act, dealing with the right of employees to organize and bargain collectively. The President ruled that there is nothing in the provisions of Section 7(a) "to interfere with the bona fide exercise of the right of an employer to select, retain or advance employees on the basis of individual merit," but added that the section does "clearly prohibit the pretended exercise of this right by an employer simply as a device for compelling employees to refrain from exercising the rights of self-organization, designation of representatives and collective bargaining."

The "merit clause" appeared in a new back-handed form, proposed by John C. Gall of the National Association of Manufacturers, in the code for the rubber manufacturing industry submitted for hearing last month. Recast as a labor, rather than an industrial, provision, the suggested clause reads: "No employee and no one seeking employment shall be deprived of his right to employment, promotion or wage increase on the basis of individual merit, without regard to his membership or non-membership in any organization."

Harper, in The Birmingham Age-Herald

Almost Ready for Flight

WINGS of unequal spread have handicapped the flight of NRA's Blue Eagle. The industrial control wing, with its codes of fair competition, maximum hours and minimum wage rates, has been growing toward full-feathered strength, but the equally important buying-power wing, thus far, has been a puny, undernourished appendage. Through a recently accelerated public works program, however, Washington has stimulated new growth in this wing of purchasing power.

Late last month allotments by the Public Works Administration had passed the $2,000,000,000 mark, with the indications that the entire $3,300,000,000 fund will be allocated before the end of the year. Although most of the money thus far has been for federal projects, the major portion of the unallotted balance will be devoted to local projects of states, cities and counties that can be placed under contract quickly.

The full and inevitable regenerative force of this phase of the recovery plan, therefore, still lies ahead, because of inherent delay in getting $3,300,000,000 of public works under actual construction. Nevertheless, thousands of men already have found employment on public works projects or in the industries supplying the equipment and materials needed for construction, for every man employed directly on the job means two others elsewhere in factory, forest or mine. The immediate prospect, therefore, is for a cumulative increase in contract awards and an extension of purchasing power through the medium of construction and industrial pay rolls that will enable the Blue Eagle to take off on a sustained flight.

Wage Scales Deter Work

● The Public Works Administration wage scale (40 to 50 cents for unskilled and $1.00 to $1.20 for skilled labor) is blamed for the reluctance of many cities to undertake construction of public improvements. There is no evidence that Administrator Ickes will reconsider the rates agreed to by the trade unions. The PWA scale must be paid on all jobs financed wholly or in part by the federal government. This includes projects on which the provisions cannot be escaped by deliberate stratagem as, for example, a division of costs under which PWA would pay for materials by grant or otherwise, leaving the local community to pay the labor on its own wage basis. This idea found favor in several towns because of the large number of men on relief rolls who are willing to work for a very low wage. It is possible that federal funds appropriated for direct relief may be combined with public works funds to create more employment, but the PWA scale will hold, according to its officials.

Labor's Responsibility Under New Deal

● Speaking before the annual convention of the American Federation of Labor last month Senator Robert F. Wagner, chairman of the National Labor Board, said in part: "The New Deal has given Labor a new charter. Labor must recognize the responsibilities which come with this freedom. The first charge upon Labor is that it abandon the philosophy of strife in its relations with employers. Industrial warfare can produce implacable hatreds and sow the seeds of depression; it can not work out delicate economic adjustments. The strike as a first resort is not prohibited by law; it is banned by common sense. The crucial point is that the strike is never more than a protest. It has no constructive force. It creates hundreds of new problems, but can not solve a single one. It should be used only as the very last resort."

For Roadside Improvement

● The Public Works Administration apparently is desirous of getting some aesthetic results out of distributing hundreds of millions of dollars for highway construction. At any rate, PWA is using its authority, as holder of the purse-strings, to launch a national roadside improvement campaign. By resolution, the Special Board for Public Works stipulates that, so far as practical and feasible, the rights-of-way for highways built with loans or grants from public works funds after Jan. 1 shall be at least 150 ft. wide to accomodate footpaths and screening by planting shrubs and trees. Safety of pedestrians and restricting signboards and other wayside eyesores are cited as the beneficial results of such a program.

No Place for Fair-Weather Dollars

THE PURPOSE of the national public works program is to make employment on construction and in the great variety of industries that are dependent on it.

So long as private capital is reluctant to undertake construction projects, this program must be the one hope of these industries. Their revival, in turn, is the only hope for continued progress in the consumer goods industries, already sagging back from their spurt under the stimulus of the NRA.

Unless we get more and more men to work on construction **and then keep them at work,** there will not be sufficient demand and purchasing power to sustain the progress already made in general industry and trade.

Let us repeat: *and then keep them at work.*

For reasons that we need not review here the public works program got away to a slow start. The delay has been unfortunate and has obstructed our progress to recovery. Now winter is upon us. So it becomes of vital importance that public works construction, already slow in starting, must be maintained at the maximum possible volume throughout the winter.

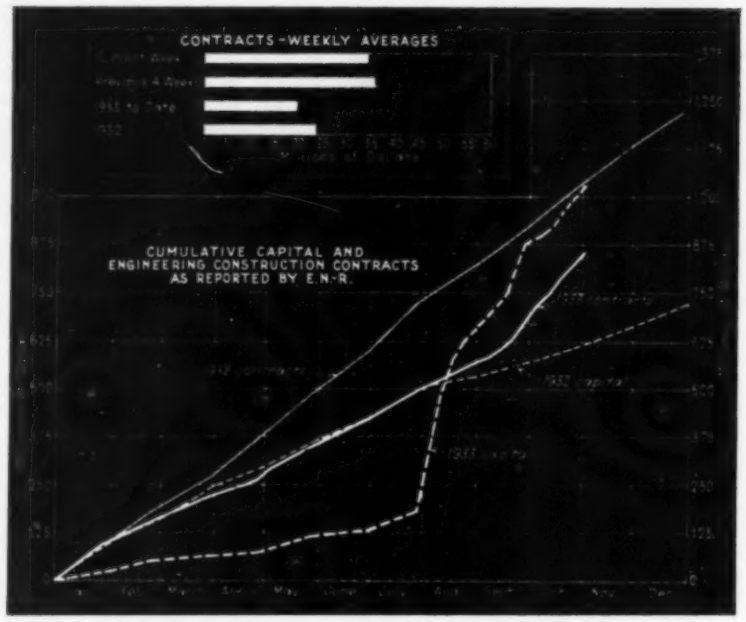
We know the tradition that construction is a seasonal industry. But during the last decade that tradition has been shattered by technical progress in the manufacture of materials and equipment and by improvement in field methods. On hundreds of jobs resourceful construction men have proved that with proper plant, planning and organization, winter work is both practicable and economical.

Today, every material, every piece of equipment, every method that makes possible the conduct of construction during the cold weather must be mobilized to insure the uninterrupted progress of public works projects during the coming winter.

If we are going to keep at work those for whom this program already has found jobs in the field, the mill, the office and the factory, if we are going to put still more people to work as a result of the contracts already signed and those yet to be awarded, we must insure that work does not lag during the winter months. A job next spring cannot provide food and shelter for this winter.

The Public Works Administration controls the issue of these funds. It should insist that they be expended on immediate and sustained construction. Departmental and local authorities should award their contracts subject to these conditions. Engineers and architects should plan to meet them. Contractors should organize and equip to comply with them. From top to bottom every authority that handles this money must see that it gets to work promptly and stays at work through thick and thin.

The need is great, the emergency is urgent. PWA dollars must be hard-working dollars. The success of the program depends on their immediate and sustained efforts. Above all they must be weatherproof; in this project for national recovery there can be no place for fair-weather dollars.



What the Chart Shows

Beginning late in July "capital", or money definitely committed for expenditure on construction, spurts upward as result of Public Works Program, and continues steep climb to $1,032,000,000 mark, nearly half a billion dollars above corresponding point on last year's "capital" curve.

With a natural lag of about 1½ months the curve of "contract awards", or money actually put to work, shows a correspondingly steep upward trend, indicating a substantially increased volume of work ready to start this winter.

Willard Chevalier
Publishing Director

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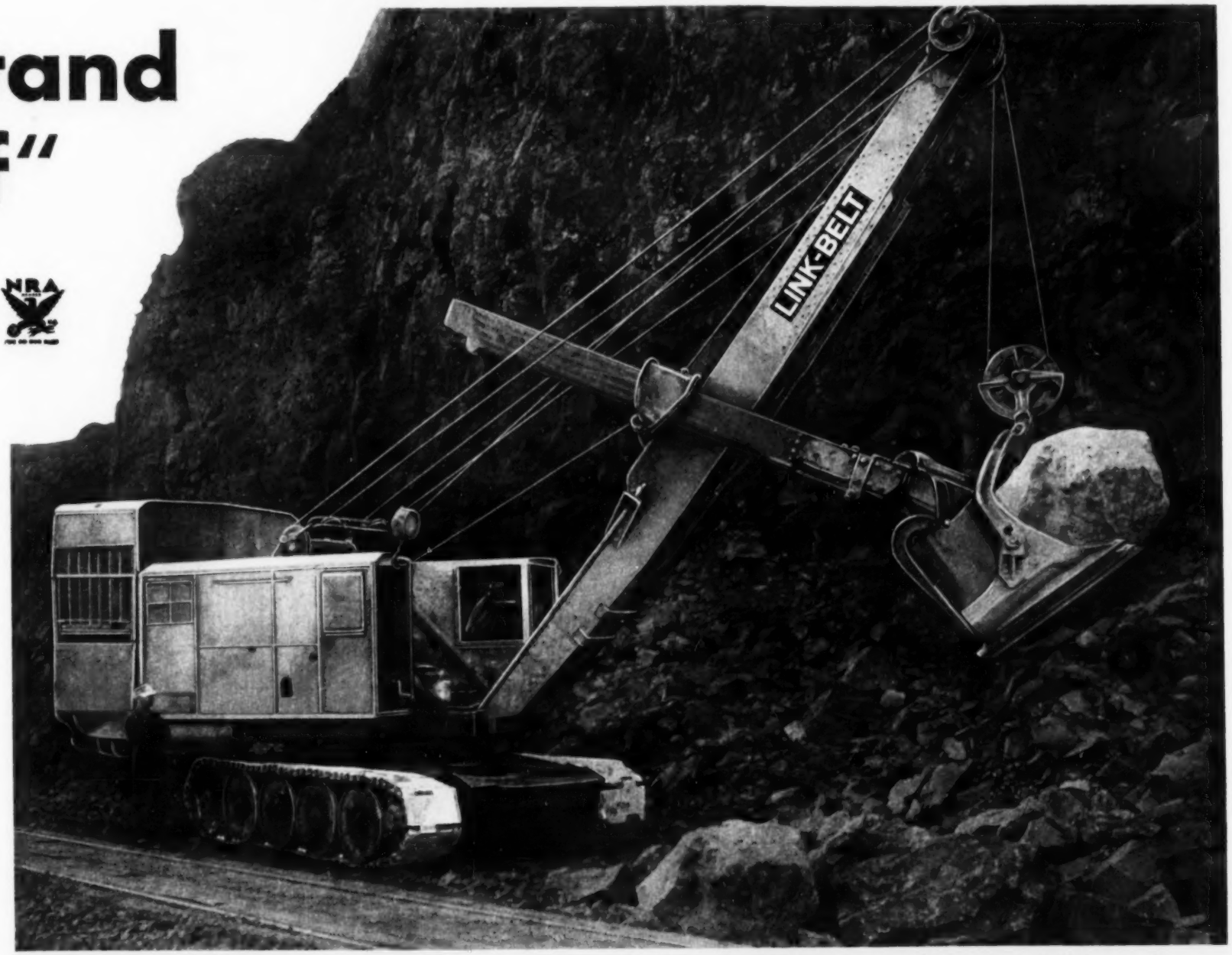


Morrison-Knudsen Co.'s Link-Belt K-55 shovel in rock excavation on Washington State Highway Contract (The North Bank Highway, Lyle-Skadat secton). This machine is four years old, and has been used continuously in rock excavation of this kind during the greater part of its life.

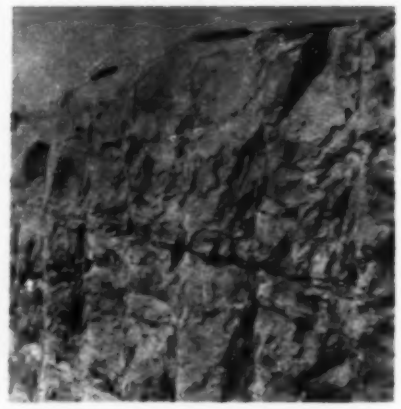
LINK-BELT SHOVEL-CRANE-DRAGLINE

Special Explosives

FOR HIGHWAY CONSTRUCTION

If you are working on Government construction work you will want this information about the use of explosives

SPECIAL conditions encountered in road building and other construction work call for special methods and materials. Explosives are required for cutting through and removing obstructions, for quarrying and ditching, and for various other operations. The following specifications, furnished by du Pont engineers, will be helpful to you in deciding upon the right explosives for use in your highway construction work:



FILL SETTLEMENT

Dynamite is effective for removing unstable material from roadbeds. Explode dynamite to create cavities for fill to drop into, and to stir up and liquefy mud surrounding the cavity to permit rapid settlement of fill.

Du Pont Ditching Dynamite is particularly effective, because of its water-resisting and propagating qualities. If necessary to place the explosive under the fill, use du Pont 40% Gelatin in large-size cartridges.

QUARRYING

If stone is to be crushed for road building, use Red Cross 40%, du Pont Extra, Gelatin, or Gelex. Holes should be well tamped and charges fired simultaneously. For quarrying dimension stone, use blasting powder of fine granulation to start cracks and seams in the desired direction. For extremely hard rock, use du Pont Quarry Gelatin.

THOROUGH CUTS

When a cut is to be made through a hill leaving a wall on either side, use du Pont Quarry Gelatin, Red Cross Extra, Red Cross Blasting Free Running Powders or R.R.P. Quarry Gelatin is made especially for wet outside work. Use the higher strengths for hard rock, and the lower ones for easier breaking rocks.

If holes are not particularly moist, Red Cross Extra will give good results. For deep holes in fairly dry work, the Free Running Red Cross Blasting Powders are very economical.

SIDE HILL CUTS

If in hard rock, use Quarry Gelatins. Softer materials are successfully handled by Red Cross Extra grades, or in dry work use Free Running Red Cross Blasting, or granular black powder.

In working from the side, slight variations are made. If excavated material is to be used for filling, the loading should be barely heavy enough to break the ground for convenient handling. In working from the end, the rules for thorough cuts apply, and the same explosives are recommended.

EARTH SIDE HILL CUTS

Use light blasts to loosen ground for road machines, or hand digging. Remove by blasting trees, stumps and boulders from both side and out-fall ditches. For widening and straightening cuts and blasting down gravel, use Red Cross Extra 20%, Red Cross Blasting No. 2 F. R. or blasting powder.

GRAVEL PITS

Blast to obtain grading material speedily. Holes are spaced about as for other blasting. If rock is not encountered, holes are loaded much lighter—merely to loosen material for easy digging. Use Red Cross Extra 20% and Red Cross Blasting No. 2 F. R.

BOULDERS

For mudcapping, remove dynamite from shell, pack it in a conical heap on the boulder; insert cap and fuse, cover explosive with several inches of thick, heavy mud. Never lay stones on top of mudcap.

For snake-holing, punch hole beneath boulder and in such a location as to ensure charge being placed against boulder. Tamp charge compactly. Use Red Cross Extra 20% or 40%, du Pont Extra D, or Agritol for snake-holing where there is heavy soil under boulders to provide resistance.

DITCHING

Ditches can be blasted in wet soil by the propagation method; the electric method can be used in wet or dry soil.

In wet soil, the propagation method, when used with du Pont Ditching Dynamite, effects economies in time, labor and money. Ditching with dynamite is frequently successful where other methods are impractical.

STUMPS

Stumps are more easily blasted from firm soil than from sandy soils. For blasting green, lateral rooted stumps, use 40% Red Cross. For tap-rooted stumps, use Agritol, or, if soil is heavy, Red Cross Extra 20%; if light soil, use Red Cross Extra 40%. To blast tap-rooted stumps out of light soil, use Red Cross Extra 40%. Du Pont Loggers' Powder for the Pacific Northwest.

Inquiries relating to selection and use of explosives should be addressed to any of our Branch Offices, or to:

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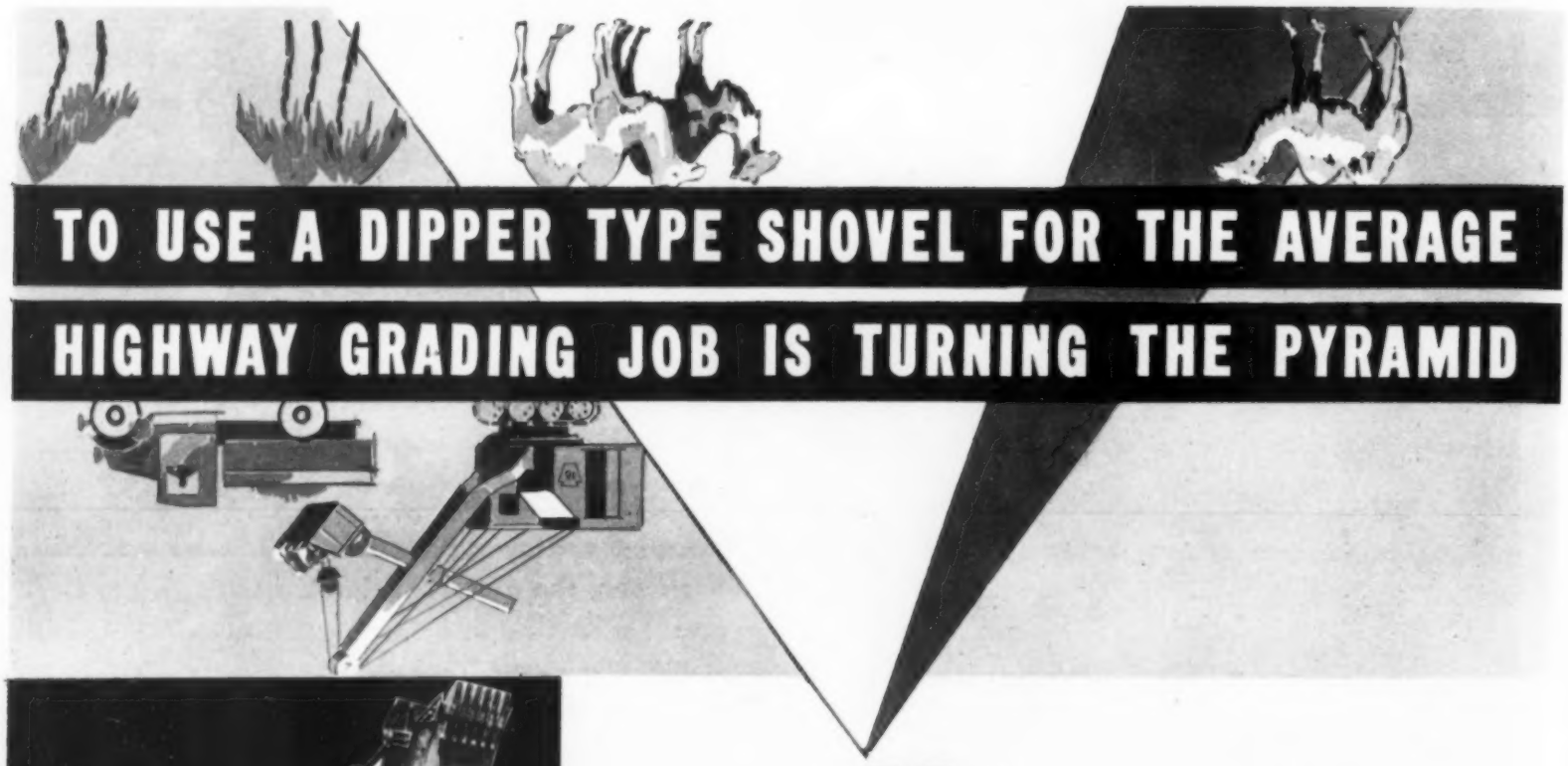
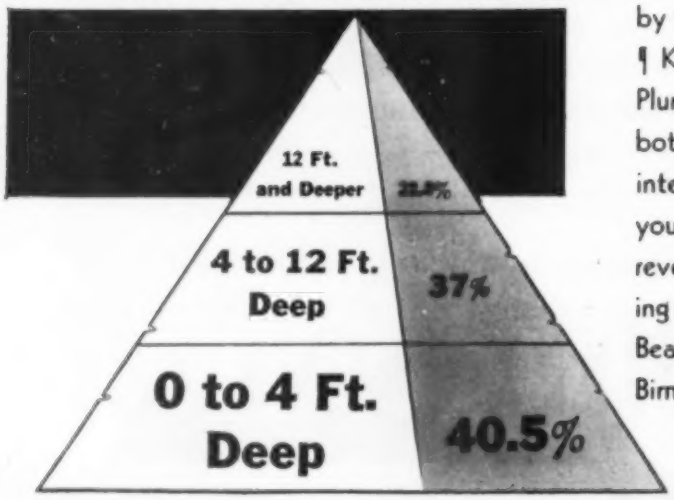


TO USE A DIPPER TYPE SHOVEL FOR THE AVERAGE HIGHWAY GRADING JOB IS TURNING THE PYRAMID

UPSIDE DOWN

DEPTH of CUTS in the AVERAGE HIGHWAY MILE



Look at the pyramid below! Analysis of 60 Highway Projects in Pennsylvania and Ohio revealed that 40.5% of all excavation is in cuts less than 4 feet deep. In every mile of excavation, 3000 lineal feet, or 85% of the total, is in this low range of depth, where the efficiency of the best dipper-type shovel is less than 50%. In these light cuts, the Keystone Model 18 PLUNGER SHOVEL is nearly twice as fast as the conventional dipper shovel. In cuts between 4 and 12 feet deep it is 15% faster, and deeper cuts can be made by benching. **The net gain is from 15% to 60% in shovel output.** These somewhat startling facts have been brought out by time studies and exhaustive analyses of highway grading requirements. ¶ Keystone Model 18 is a full-revolving excavator equipped as a Dipper, Plunger or Trench Shovel, Hammer or Crane with Clamshell, etc. Making both Dipper and Plunger utilities, we are neutral as to choice. Our only interest is to see that you get the utility which will be most efficient for your work. ¶ Before you bid on another job, send for the full facts as revealed by an exhaustive study of highway grading projects and excavating costs. Just ask for Bulletins Nos. 2 and 3. ¶ Keystone Driller Company, Beaver Falls, Pa. (Established 1882). Branches: Arlington, N. J., Joplin, Mo., Birmingham, Ala., Waukegan, Ill.

DIPPER SHOVEL · PLUNGER SHOVEL · TRENCH SHOVEL · HAMMER · CRANE

KEYSTONE 18

Construction Methods

ROBERT K. TOMLIN, Editor

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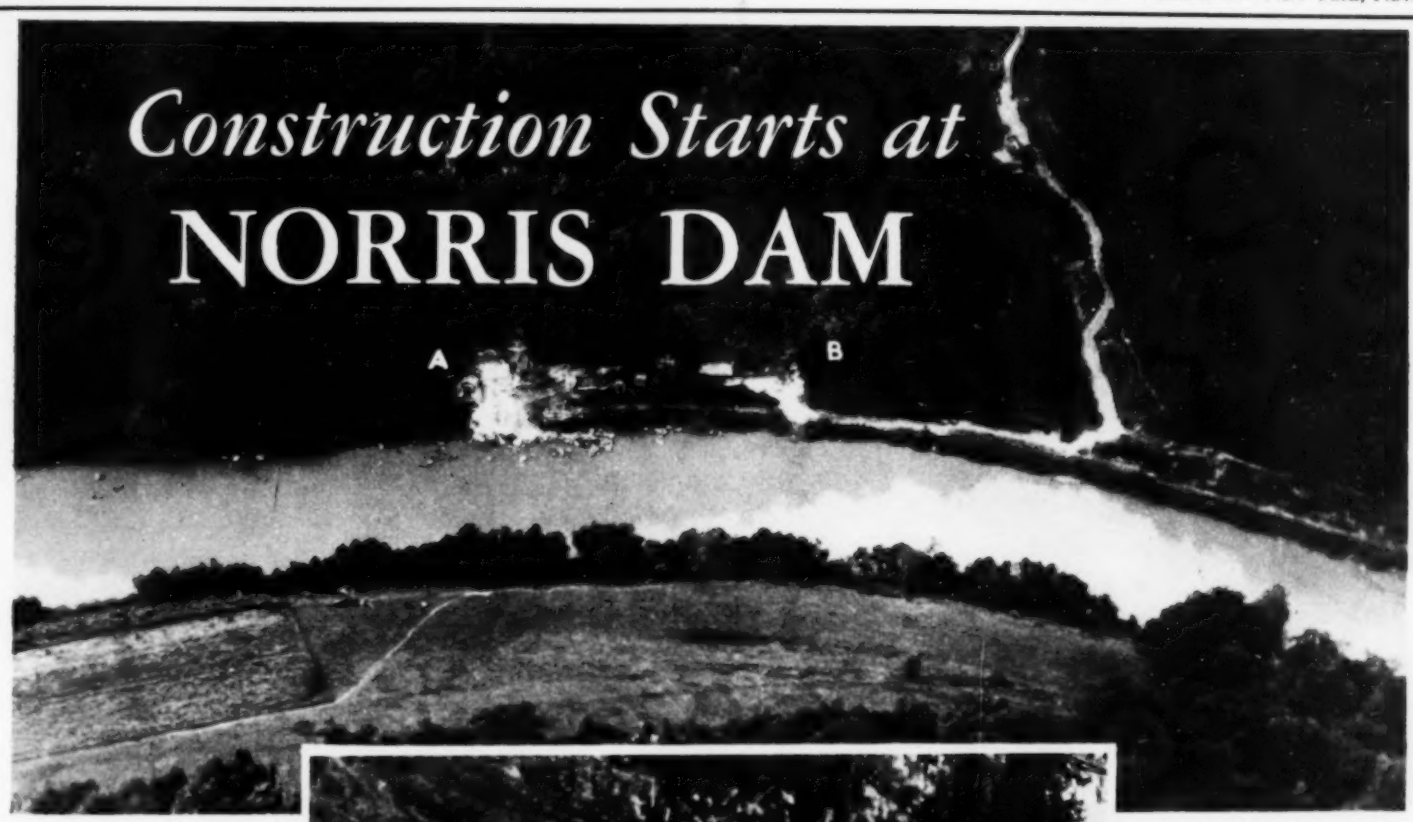
Construction Starts at NORRIS DAM



SITE of Norris Dam on Clinch River, Tennessee, showing work started on exploration shaft (A) and tunnel (B).

WORK is under way on the $35,000,000 Norris Dam of the Tennessee Valley Authority on the Clinch River in Tennessee. An exploration shaft to be sunk 100 ft. is well down and two exploration tunnels are being run back into the hill that forms one abutment to determine the character of the limestone bedrock at the site. Based on the excellent character of the foundation as shown by these workings made to check the previous examination of the site, details of the design of the dam have been determined.

Meantime, contracts for plant and equipment needed to build the dam are being awarded by the Tennessee Valley Authority which will handle the construction work by force account with C. H. Locher, as construction consultant, and Ross White, as construction superintendent. Dr. A. E. Morgan, chairman of the Authority, will have general supervision of the project.

Tests of the limestone at the site indicate that it will be better to use sand and crushed stone from this material than to import either the sand or gravel for concrete. This will mean the excavation and crushing of more than 1,000,000 yd. of rock and the reduction of a good part of it to sand sizes.

STARTING 6x9-ft. exploration shaft, to be sunk 100 ft. to determine character of rock at damsite. Reports since picture was taken indicate dolomitic limestone to be free of fissures, laminations or caves.

Work on the dam will be handled by cableways spanning the site. The concrete mixing plant and all other equipment will be electrically driven.

Ability to use local limestone for concrete eliminates the need of the railroad to the damsite planned in the original estimates. Instead, a heavy-duty highway will be built to bring in the supplies and materials required for the job. It is expected to use this highway also for moving to the site from rail connection all the large power units for the generating station that will be a part of the project.

Present prospects are that the job will be well under way early in 1934. The plans are to run night and day with full forces. All employees will work 30 hr. a week and will be given a chance to attend trade schools set up by the Authority.

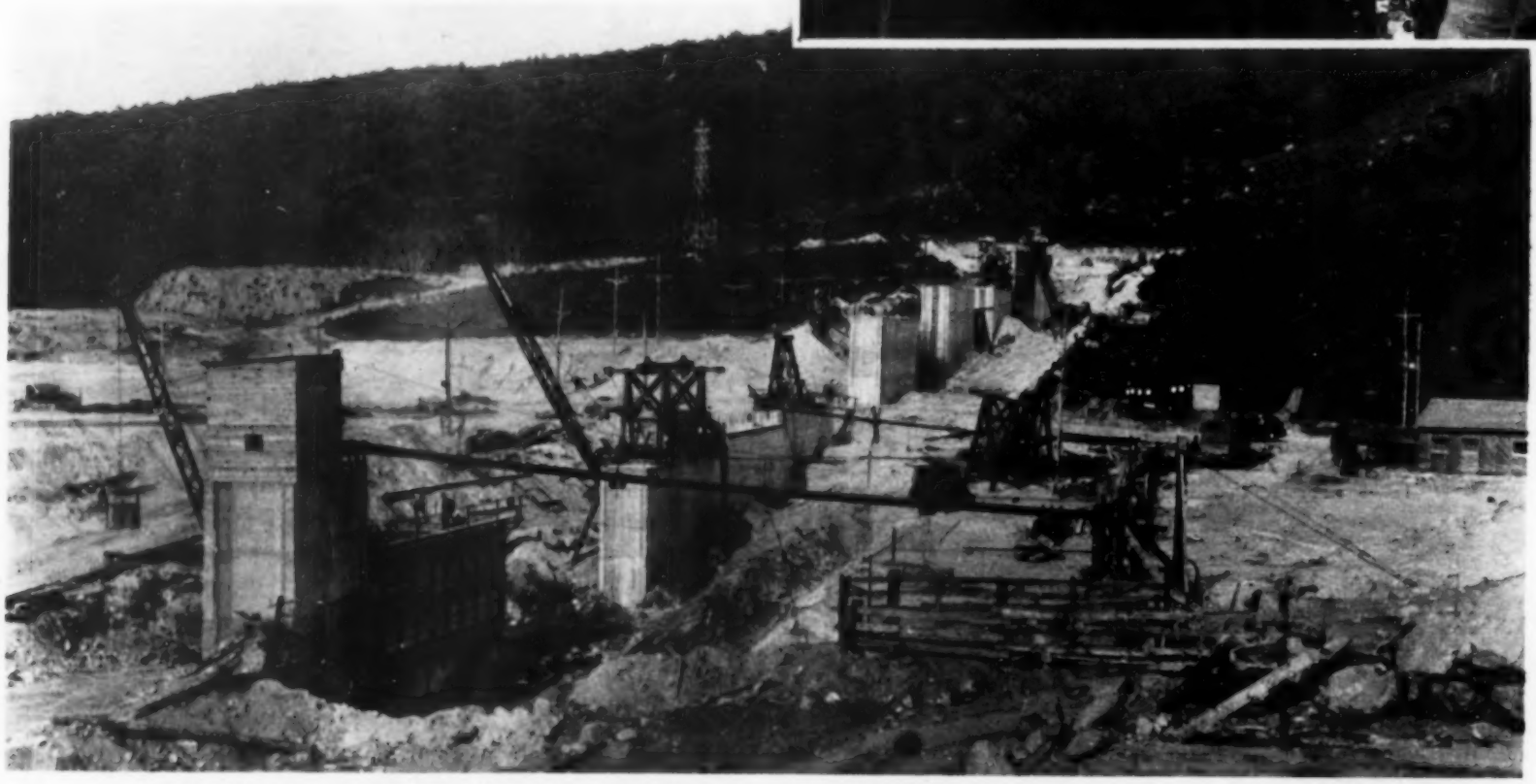
A model town will be built to house the construction crew and later the operating organization. Permanent water supply, sewerage and other municipal services will be provided. Employees will have ample ground on which to grow most of the vegetables and fruits they need for their own use.

This Month's

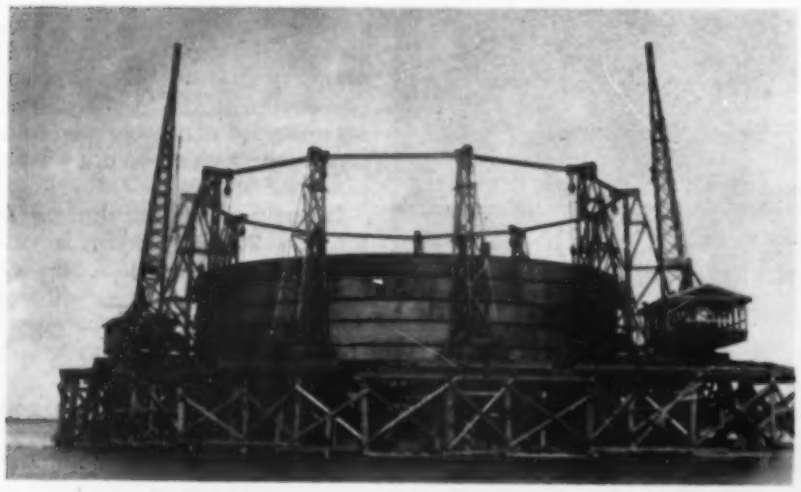
"NEWS REEL"

SLUM CEARANCE *(right)* prepares way for Knickerbocker Village, model housing project in New York City financed with aid of government loan amounting to $8,075,000 from the Reconstruction Finance Corporation. Former Governor Alfred E. Smith swings sledge to wreck first old tenement on site while Fred F. French, builder and sponsor of the project, holds chisel. Project, providing 1,595 apartments in two 12-story buildings, will replace "blighted" area of 219,736 sq. ft.

Acme Photo

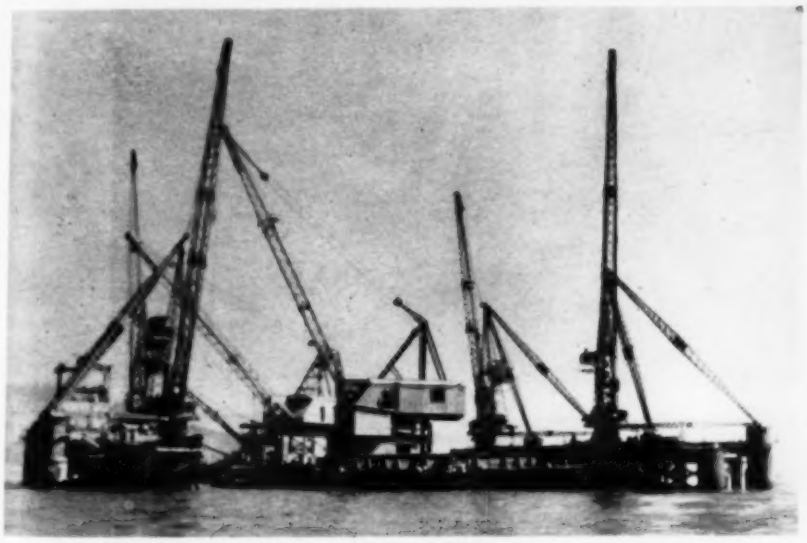


COREWALL OF 31 CONCRETE CAISSONS, each 9x45 ft. in plan, sunk end to end to depths of 40 to 140 ft., forms 1,500 ft. long waterstop in earth dike closing depression in hills surrounding Quabbin reservoir, being built for Metropolitan Water Supply Commission, of Boston. Earth dike is 135 ft. high and 2,140 ft. long. Pneumatic sinking was facilitated by lowering ground water level by extensive pumping and using simple water jets under cutting edges of caisson working chambers. Contractors, West Construction Co., of Boston.

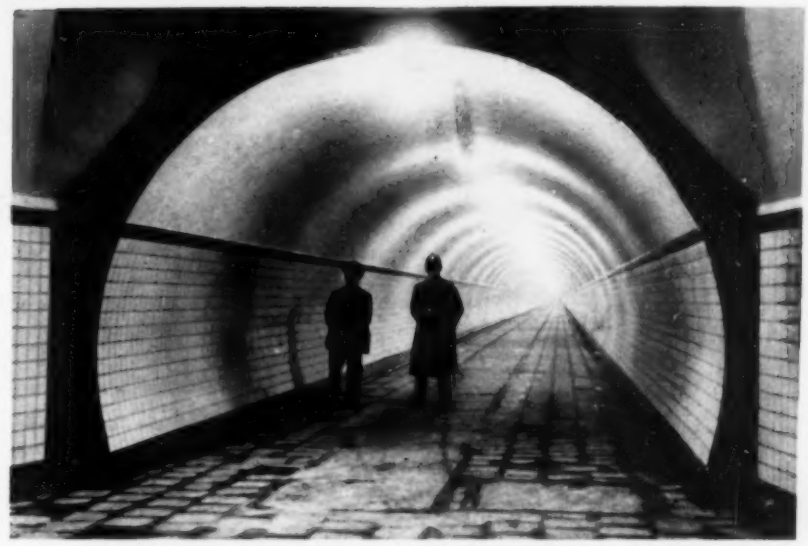


HOLLOW STEEL SHELL, 121 ft. in diameter *(left)*, is built up by Siems-Helmers, Inc., on 135-ft. timber pile falsework and lowered to bottom for pier foundation of Mississippi River bridge at New Orleans, La. Shell is filled with sand to form "island" through which caisson of concrete is sunk by dredging through caisson wells. Concrete for walls is poured in 10-ft. lifts by floating plant until caisson reaches river bottom *(right)*. Four of the river caissons for the bridge piers are founded at 170 ft. below mean Gulf level.—*Photos from* J. H. LEVY, *Siems-Helmers, Inc., contractors, New Orleans, La.*

MISSISSIPPI RIVER LOCK No. 20, at Canton, Mo., passes from excavation stage (illustrated in *Construction Methods* for June, p. 17) to concreting stage. Work on lock walls by Maxon Construction Co., Inc., of Dayton, Ohio, proceeds within cofferdam having walls 32 ft. high above bedrock and enclosing area of 13 acres. Concrete mixing plant, at rear, uses bulk cement and sand and gravel dredged from river; batches are handled to forms by whirley cranes. Under supervision of Corps of Engineers, U. S. Army, work for contractor is in charge of F. R. Clement, superintendent.



WORKING DOCKS on pile bents at central anchorage pier for 7-mi. long, $60,000,000 San Francisco-Oakland Bay Bridge in California. Four stiff-leg derricks are excavating and placing concrete for the 92x197-ft. caisson foundation in water 70 ft. deep. Contractor, Trans-Bay Construction Co.



SUBAQUEOUS TUNNEL FOR PEDESTRIANS has been completed under Schelde River at Antwerp, Belgium. Bore 1,750 ft. long, is formed by cast-iron rings lined with concrete to give interior diameter of 14 ft. 9 in., and walkway 12 ft. 6 in. wide. Shafts for tunnel were sunk by freezing process. Consulting engineers, Parsons, Klapp, Brinckerhoff & Douglas, of New York.

Globe Photo

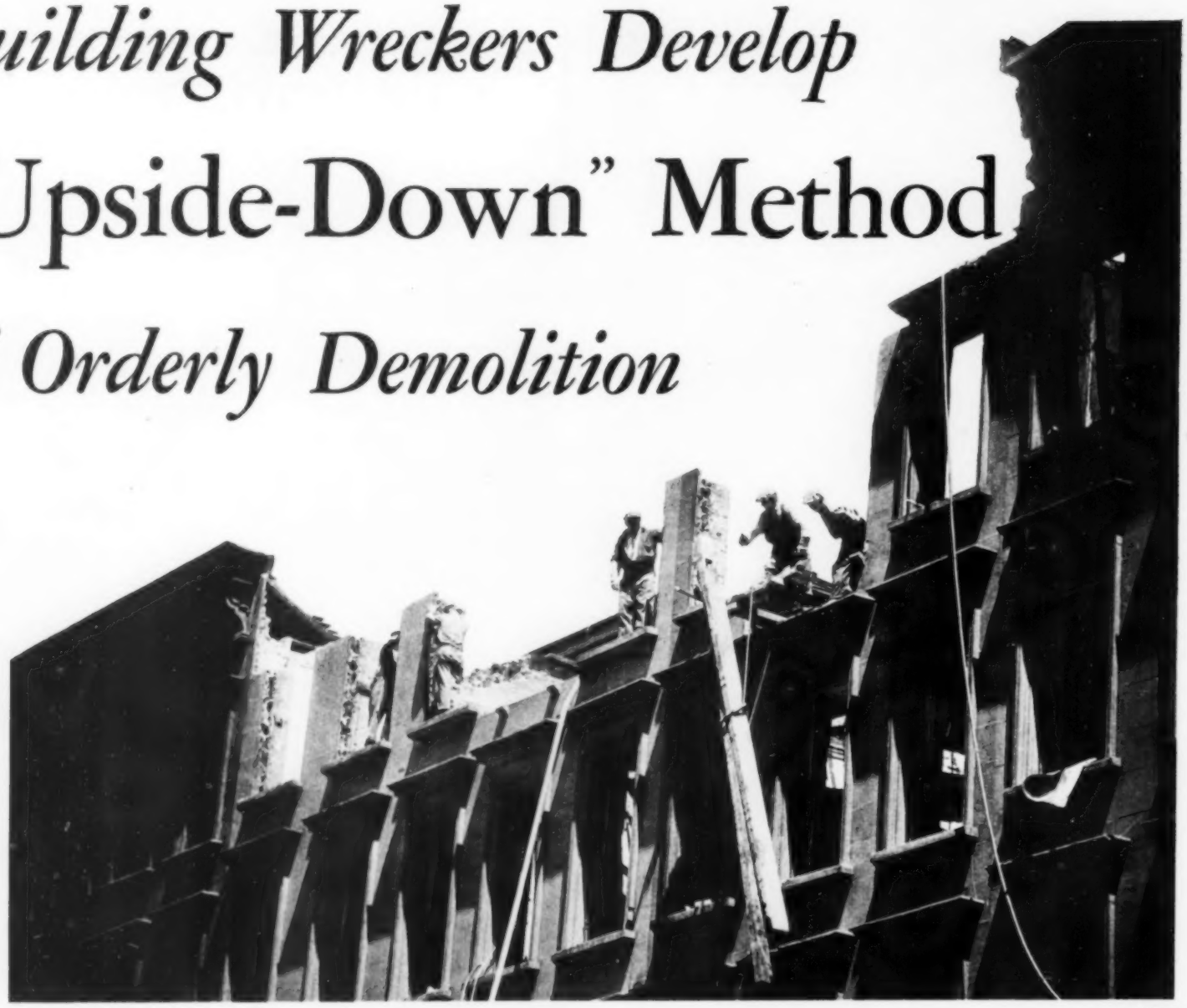
TECHNICAL BOARD OF REVIEW of Federal Emergency Administration of Public Works meets to pass on loans and grants for construction projects in $3,300,000,000 public works program. *(Left to right)* Major Merton L. Emerson, of Boston; Major R. S. Buck, of New York; Major Carey H. Brown, chairman of board; and David C. Coyle, of New York.

Harris-Ewing Photo

Building Wreckers Develop

"Upside-Down" Method

of Orderly Demolition



Browning Photo

Construction in Reverse Gear

● In the public works section of the National Industrial Recovery Act definite provision is made for spending part of the $3,300,000,000 fund on "low-cost housing and slum clearance projects." Soon after the Federal Emergency Public Works Administration was organized under the terms of the Act, a Housing Division was formed, with Robert D. Kohn, past-president of the American Institute of Architects, as its director. As a result, a decided impetus has been given to large-scale housing projects throughout the country. Already loans of federal funds running into millions have been allocated and additional millions are in prospect for this purpose.

● These developments make the accompanying article particularly timely. Before blighted areas within city limits can be improved, it becomes necessary to demolish and remove existing slum structures. For the construction man, therefore, a new significance attaches to the operation of large-scale building demolition, a subject upon which comparatively little information has appeared in print. In this specialized field, where ordinary construction practice is thrown into reverse gear, there has been developed an orderly procedure and a technique of field practice exemplified by the extensive house-wrecking operations which were necessary to clear the site for the immense Rockefeller Center group-building project in the heart of New York. Engineers and contractors, generally concerned only with methods and equipment for erecting structures, will find in the article herewith valuable information on how best to tear them down. —EDITOR

DEMOLITION, the necessary precursor of construction on many city projects, is not the crude and uncouth advance agent which the untidy appearance of its jobs might suggest. The building wrecker, as well as the builder, has accumulated a fund of experience, developed new practices, adapted power machines to unintended uses, and generally refined his technique until he has become as able a craftsman in his way as the constructor who follows him. At Rockefeller Center, occupying three large blocks in midtown Manhattan, New York City, a vast amount of orderly destruction had to precede the construction of office buildings, theatres, and shops. The managers of the project entrusted to the Albert A. Volk Co., Inc., of New York City, in three separate contracts, the removal of about 200 buildings. This company carried on its work with skill, speed, and safety, employing its original "upside-down method" of gutting and razing buildings.

Contracts for demolition of old buildings at Rockefeller Center were awarded as plans for the various new structures reached the acceptance stage. The accompanying photographs were taken on the last of these contracts, calling for the removal of 35 buildings which included both skeleton-frame and wall-bearing types. Three skeleton-frame buildings were of fireproof construction, and the wall-bearing structures were fireproof, semi-fireproof, and non-fireproof. The fireproof buildings had steel floor framing and concrete floors; the semi-fireproof, steel framing with wood interframing; and the non-fireproof, wood frames and floors.

Upside-Down Method—By the upside-down method of demolition, the Albert A. Volk Co. starts wrecking the interior of the structure at the bottom instead of at the top. Only enough of the structural frame is left intact to support the walls. As the demolition proceeds inside the building, the debris is permitted to fall and accumulate at the bottom of the building shell. After stripping the interior by this process, the contractor begins at the roof to take down the walls, floor by floor, ordinarily dropping the debris from this operation inside the building as before.

When wrecking has proceeded as close to the first floor as the accumulated debris will permit, a power shovel attacks the mass of wreckage, completing the destruction of the walls and loading the material into trucks. Because of the time saved both in demolishing the structure and in loading the debris, the upside-down method is much faster than the common practice of starting wrecking operations at the top of a building and using chutes from the upper floors to loading hoppers as

houses had been built with party walls, it was necessary only to wreck the front and rear walls and partitions to complete this first step of the demolition process. With the key buildings removed, the wreckers were able to push down the walls of the adjoining residences a full story at a time, saving the labor of breaking the masonry with sledge hammers and bars.

To push down a wall, the wrecking crew placed inclined timbers, or rakers, with the upper end resting against the wall to be dropped and the lower end braced against the opposite solid wall. By using pinch bars to pry against the unsupported wall at the end of the timbers, the rakers were worked down and the wall pushed outward until it broke off at the floor level and dropped. This operation was repeated for each story height of wall, and the same method was used on successive party walls.

As the non-fireproof residences had wood floor frames and flooring, it was necessary to preserve the rigidity of the floor system in order to maintain stability in the structures. For this reason, the contractor disturbed the floor joists as little as possible, merely cutting trenches in restricted areas of the floor

PIERS AND SPANDRELS *(left)* **of ornamental brownstone front are pulled over by system of ropes leading to block and tackle operated by crew of wreckers.**

THREE CITY BLOCKS of residences and commercial buildings disappear under skilled attack of demolition experts at Rockefeller Center. Two blocks in foreground have been largely cleaned up by power shovels and trucks. Sidewalk bridge erected along portion of block in background presages early destruction of these buildings.
Keystone Photo

a means of disposing of the rubbish. Details of the wrecking procedure by the upside-down method depend upon the type of structure and upon surrounding conditions.

Group Demolition—The 35 buildings included in the third Volk contract formed a solid group occupying the east end of the block bounded by 5th and 6th Aves. and 50th and 51st Sts. On the 5th Ave. frontage, the buildings were of fireproof or semi-fireproof construction, ranging in height from a six-story wall-bearing structure to a twelve-story skeleton-frame building. The buildings facing 50th and 51st Sts. on the other hand, were almost exclusively non-fireproof residences five stories high, with a few four stories in height. For the 26 buildings of this description, the contractor adopted a more rapid method of demolishing the walls.

By this method, the wreckers removed key buildings at intervals along each row of residences. As most of the

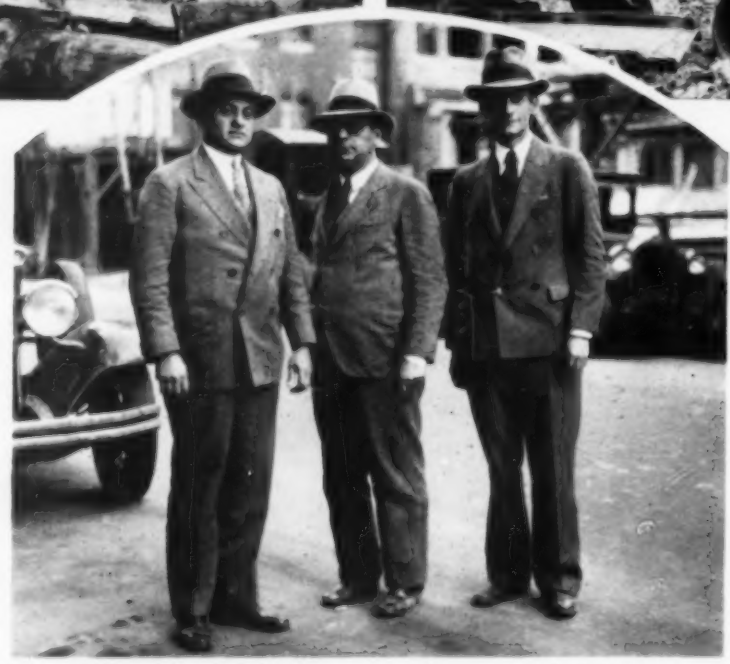
THREE-STORY VAULT *(right)* **reinforced with steel channels presents unexpected obstacle to orderly progress of demolition but yields rapidly to concentrated destruction methods.**

POWER EQUIPMENT replaces hand methods of loading. Crane handles salvaged steel and tanks.

GASOLINE SHOVEL transfers accumulated debris inside wrecked building to trucks for disposal.

to pass material dropped from above in carrying on the upside-down process of demolishing the interior.

The same method of pushing down the side walls of buildings has been used successfully by the Albert A. Volk Co. in demolishing wall-bearing structures with steel floor frames. In the case of these buildings, the contractor can remove both the flooring and the wood secondary framing when cleaning out the interior, as the steel floor frames alone are adequate to support the walls. Although it would be possible to use a similar method of pushing down the curtain walls on skeleton-frame buildings, the practice would require the cutting of chases to separate the masonry from the steel, and the cost of this



A. K. FLESCHNER (left), secretary, Albert A. Volk Co., Inc.; MICHAEL SHERIFF, superintendent, and CHARLES FLESCHNER, assistant superintendent.

operation would exceed that of taking down the walls by the use of hanging scaffolds.

Stripping Interior—As the first step in wrecking many of the buildings, the contractor salvaged mantelpieces, doors, wood panels, chandeliers, and any other objects of value. These objects were sold to dealers or to private buyers and, in a few instances, were given to museums. Following the salvaging of the valuable decorative features, the wreckers trimmed out the interior of the buildings, stripping the plaster and lath and removing all wood except that in the structural frame.

On the smaller buildings, the wood was thrown out on the sidewalk bridge. In the taller structures, wood was made

SLEDGEHAMMERS AND BARS are used to break up concrete floor slabs between beams of fireproof building. Workmen stand on planks or steel members.

SIDEWALK BRIDGE *(below)* protects pedestrians during demolition and serves as loading platform. Note openings cut through party wall of dwellings.

WOOD JOISTS are turned flat on lower flanges of steel floor beams to provide temporary working platform during demolition.

ON STEEL-FRAME BUILDINGS wreckers use suspended scaffolds to demolish exterior walls.

up on each floor into firewood bundles to fit trucks and later was loaded on to trucks in the street by the steel derricks. Heavy wood pieces were saved or sold for rough use, the joists and miscellaneous doors largely were disposed of to small outlying lumber yards.

Wrecking Walls — After trimming out the interior of a building and removing as much of the floors as was desirable or as the type of structure permitted, the wreckers removed the roof and roof frame and began the demolition of the walls. On the residential buildings, the walls were pushed over one story at a time, as already described, but on the taller wall-bearing fireproof and semi-fireproof structures the masonry was broken down with sledge hammers and bars.

In the case of the fireproof wall-bearing buildings, the contractor was able to remove all the concrete from the floors wherever desired, leaving only the steel frame to stiffen the structure. On the semi-fireproof structures, the wreckers stripped all the flooring and turned the wood joists, resting on the lower flanges of the I-beams, from vertical to flat position to form temporary floors during the demolition of the walls. Floor frames in all the wall-bearing buildings were removed as the

LADDER ENTRANCE to building being demolished is protected from falling objects by overhead catch platforms.

POWER SHOVEL demolishes two-story wall at great saving in time and labor.

TO KEEP DOWN DUST, hosemen continuously play streams of water on accumulating debris.

wall demolition reached the various floor levels.

Skeleton-Frame Buildings—Depending upon the strength of the frame and the height of the building, a wrecking contractor may strip the entire skeleton before starting to demolish it or he may begin burning and dismantling the steel after four floors have been completely stripped. Both methods were employed by the Albert A. Volk Co. at Rockefeller Center. In using the second method, of stripping the frame and dismantling the structural steel simultaneously, it was required that the wreckers keep at least four floors ahead of the ironworkers.

When first gutting the interior of a skeleton-frame building, the wreckers could cut as many openings in the floors as seemed advantageous. Usually the contractor cut a trench in the concrete floor around the entire periphery of the building adjacent to the exterior curtain walls. Suspended scaffolds were hung from the top of the steel frame on the outside of the building to permit wreckers to work safely and rapidly in demolishing the masonry walls. Unless the masonry was of unusually heavy construction, the workmen broke up the walls with sledge hammers and bars, allowing the debris to fall through the floor trenches to the basement of the structure.

When the frame had been stripped to a sufficient extent, the contractor erected a guy derrick on the top of the steel skeleton and began burning and

FIREWOOD BUNDLES to fit truck bodies are made up on floors and later are lowered to street by derricks.

dismantling the steel. Oxy-acetylene torches were used to cut the steel into sections for handling by the guy derricks, which lowered the steel to the ground outside the building where the pieces were made up in bundles for loading on trucks. Derrick moves were just the reverse of those made in erection, the derrick being "jumped" down two stories at a time wherever the columns were in two-story lengths.

Safety Measures—In addition to using suspended scaffolds in demolishing the curtain walls of skeleton-frame structures, the contractor also erected catch scaffolds on tall buildings to intercept any dislodged material which otherwise might have fallen through the sidewalk bridge. One of the photographs shows a catch scaffold installed under the overhanging cornice of a twelve-story building. This scaffold was moved down four stories at a time as demolition of the walls proceeded.

Workmen traveling between the ground floor and the upper floors of buildings that are being demolished are in great danger, especially in the taller structures, of being struck by falling objects. To avert this hazard, the Albert A. Volk Co. maintained fully inclosed safety stairways in all the tall buildings. Sidewalks were protected by bridges substantially constructed of salvaged lumber from the buildings. Windows of structures more than five stories high were boarded up completely to prevent the escape of dust and, what is more important, of debris deflected in falling. The contractor installed water lines and detailed workmen to play streams of water on the rubbish, thus preventing formation of obnoxious clouds of dust.

SKELETON FRAMES of commercial buildings facing Fifth Ave. and St. Patrick's cathedral are cut up by torches and lowered to trucks by derricks.

A fully equipped job hospital was maintained on the second floor of one of the buildings, with a physician in attendance at certain hours. At other times, first aid was given at this station pending the arrival of the physician.

Insurance—Because of the high rate of compensation insurance which underwriters find it necessary to charge building wreckers, the Albert A. Volk Co., Inc., has found it more economical to carry its own insurance. This self-insurance has been put into effect in compliance with the laws of New York State, which require posting a deposit to guarantee protection of the workmen.

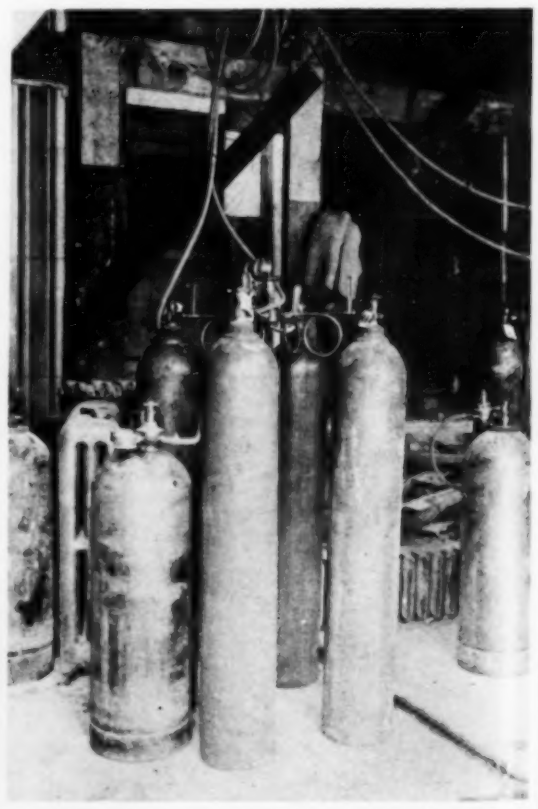
Reclaiming Materials—Pipe, conduit, scrap iron, and other metals salvaged during the demolition of the buildings were made up in bundles for loading on to trucks. The contractor, because wrecking operations were ahead of schedule, was able to permit a number of unemployed men, called "Klondikers", to work on the premises, cleaning old brick and selling them for what they could get. The rest of the brick were hauled away and dumped in swamps and fills about the city.

Power Shovels and Cranes—A 1½-yd. gasoline shovel could load a 7-yd. truck in 3 min. as compared with ½ hr. by means of a chute. The power shovels furthermore were effective in rapidly demolishing first-story walls left standing by the wreckers. A power crane proved useful in sorting and loading structural steel.

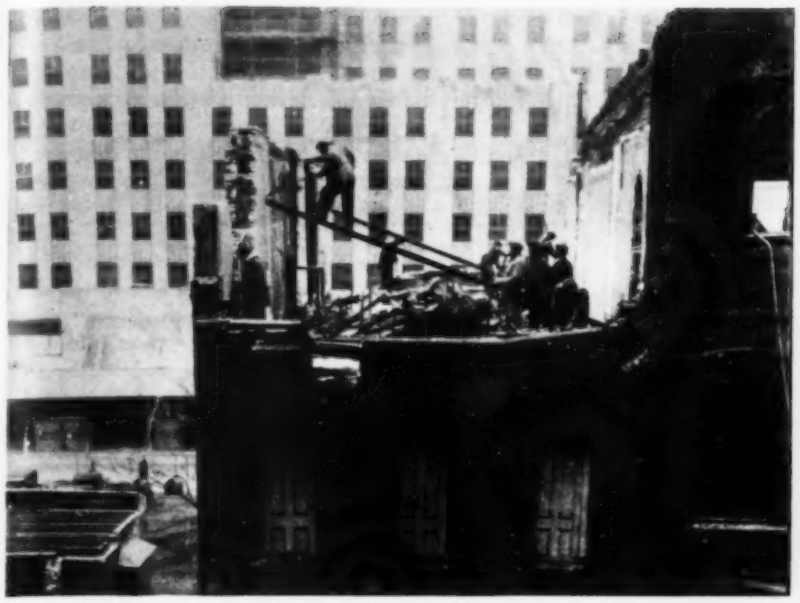
Workmen—Skilled laborers on demolition work are known as barmen. These men perform the more hazardous work of breaking down the walls with sledge hammers and bars and build sidewalk bridges, safety stairways, and

OXY-ACETYLENE TORCHES are used to cut steel members into convenient sections for handling.

SAFETY MEASURES. Catch scaffolds on tall buildings intercept falling objects which might pierce sidewalk bridge. All windows are boarded up to prevent escape of dangerous missiles and dust.



TANKS of oxygen and acetylene are placed in safe position on sidewalk. Four oxygen tanks connected to single manifold eliminate frequent changes.



PARTY WALLS between dwellings are pushed over, one story at a time, by placing inclined timbers against unsupported wall and working timbers down with pinch bars.

WORKMEN ON INCLINED TIMBERS continue process of pushing wall outward until it breaks off at floor line and falls into adjacent basement.

other temporary structures requiring skill. The unskilled laborers do the shoveling, cleaning, piling, loading and other work requiring little training.

Features of Contractor's Plant—In addition to the shovels, cranes and derricks, the contractor used a number of smaller machines on the demolition work. Several of the buildings had walls of heavy stone masonry. To prepare this masonry for demolition by the barmen, the contractor drilled holes in the walls about 2 ft. apart vertically and 3 ft. apart horizontally to permit the insertion of plugs and feathers. The holes were cut with pneumatic drills operated by air from a portable compressor. In some cases, pneumatic tools

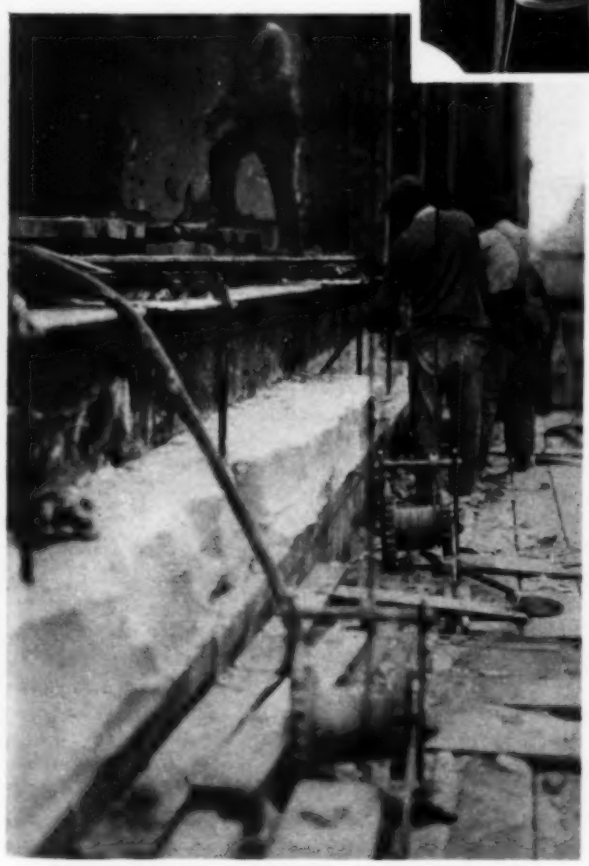
IN SPITE OF SAFETY PRECAUTIONS, house wrecking still is hazardous occupation. Job hospital gives first aid and takes care of minor injuries.

alone were used to break up the stone masonry. A heavily reinforced concrete vault was discovered in one of the non-fireproof buildings on 51st St. This vault was eaten away with pneumatic tools and oxy-acetylene torches.

As the water supply to the buildings was shut off at the start of the wrecking work, it was necessary to install special exterior risers to provide water for the important work of wetting down the debris. These exterior pipe lines were connected to the old supply mains inside the cellars. On the taller buildings, the pressure in the mains was insufficient, and the contractor had to use pumps to lift water to the tops of the structures.

To avoid the danger of raising oxygen and acetylene tanks to the upper floors of the buildings, where they might roll and drop through an opening, the contractor placed these tanks on the sidewalks outside the buildings and ran hose lines to the torch operators. A manifold connection permitting four oxygen tanks to be hooked up to one hose line provided sufficient oxygen to use up an entire tank of acetylene and saved the operator frequent trips to the ground floor to replace exhausted tanks of oxygen.

Supervision—All operations at Rockefeller Center are under the general supervision of Ernest L. Smith, project manager for Todd & Brown, Inc., which supervises construction for the Todd, Robertson & Todd Engineering Corp., general manager of the project for Rockefeller Center, Inc. Demolition work of the Albert A. Volk Co., Inc., was directed by A. K. Fleschner, secretary of the company, and by Michael Sheriff, superintendent.

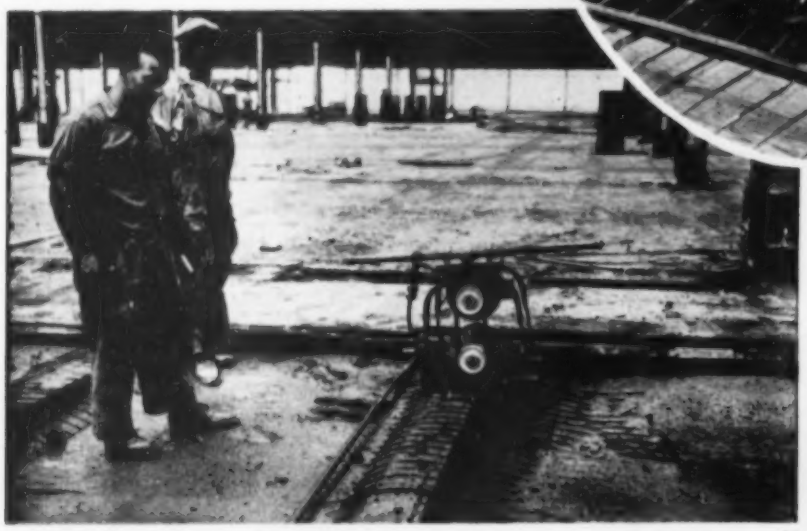


HEAVY STONE MASONRY first is drilled with pneumatic tools and then is broken up with plugs and feathers by men working on hanging scaffold.

SKILLED WORKERS manipulate bars and hammers on walls and partitions. Note pipe riser to deliver water for wetting down debris.

Clamped to Steel Building Frame
ELECTRIC VIBRATORS
Produce Dense Cinder Concrete for Floor Arches and Fireproofing

PORTABLE electric vibrators clamped to horizontal members of the steel frame of the new Philadelphia Post Office served to fill completely with densely compacted cinder concrete the floor-arch, beam and column forms of this project for the Wallin Concrete Corp., of New York, subcontractor under Starrett Bros. & Eken, Inc., which holds the general contract for the building. Introduction of mechanical vibration after the first two floors had been concreted eliminated the large amount of hand puddling which originally had been necessary. Mechanical vibration also produced a dense, smooth surface on exposed beam and column fireproofing and on the underside of the floor arches, practically eliminating all need for patching and greatly reducing the cost of finishing operations. By the vibratory method of placement, therefore, the contractor was able to provide a dense cinder concrete, strongly bonded to the steel, at lower cost than would have been possible with hand puddling.



ELECTRIC VIBRATOR attached to steel floor beam consolidates cinder concrete in beam form and on adjacent slab forms.

TWO MEN move vibrator and quickly attach it to beam flange *(in oval, above)* by simple locking device

Structural Features of Building—The Philadelphia Post Office is a steel frame and concrete structure consisting of five floors and a roof. Exterior walls are to be of brick and granite. The area of a typical floor is about 372x460 ft., divided into typical bays of 50x26 ft. Each bay contains eight panels separated by 18-in. floor beams spaced 6¼ ft., c. to c.

A cinder concrete of 1:2:4 proportions, containing cinders retained on a ¼-in. screen, was specified for fireproofing and floor arches. All floors except the fifth have 4½-in. cinder concrete arches reinforced with welded wire mesh. On the fifth floor, the reinforced cinder concrete arches have a depth of 5½ in. Fill and finish to the depth of about 5 in. is to be placed on the floor arches. A 4½-in. slab of stone concrete was specified for the roof, which is designed for use as an airplane landing field. The contract of the Wallin Concrete Corp. called for about 45,000 yd. of concrete, of which about 33,000 yd. was cinder concrete. After placing the cinder concrete in the first and second floors by the hand puddling method, the contractor adopted portable electric vibrators to compact the material on the third, fourth and fifth floors.

Design of Vibrator—Two types of portable electric vibrator, recently developed by the International Steel Tie Co., of Cleveland, were operated at the new Philadelphia Post Office. The machines were adaptations of the mortar flow pulsator manufactured by the same company and used for years in street railway track work to compact concrete and bond it to the steel. In principle, the two types of vibrators were similar. In each type, the vibratory element consisted of an eccentric flywheel driven at high speed by cog belt from an electric motor spring-mounted to free it from the effects of vibration. The first type tested at the Post Office was supported by a frame of two light steel channels resting across the upper flanges of two floor beams to which it was securely attached by bolted clamps. No auxiliary supporting frame was required by the second type of vibrator, which was clamped directly to the upper flange of a floor beam or girder.

First Type—In the first type the eccentric flywheel and electric motor were mounted in horizontal position on a steel bedplate, with two V-type cog belts connecting the pulleys of the power and flywheel units. The motor was mounted in a rectangular steel frame on 24 coil springs, six on each side, which absorbed the vibration shocks and prevented injury to the power unit. A wooden crossbar was provided at the top of the machine to enable two men to carry it. The vibrator weighed about 250 lb.

A frame made up of two 3-in. channels about 8 ft. long supported the vibrator. These channels were connected at three points by pipe spacers which provided a space of about 2 in. between the channels. Bolted clamps, adjustable in longitudinal direction between the channels, locked the frame at both ends to the upper flanges of two floor beams, as illustrated. The vibrator was equipped with two hooked dogs, one fixed and one adjustable, which engaged with two of the pipe spacers of the frame. When moving and setting a vibrator on a new frame two workmen engaged the fixed dog with one spacer and then tightened up the second dog by a screw device until the

machine was rigidly attached to the frame. To remove the vibrator from the frame, the men first unscrewed the locking screw of the adjustable dog and then applied power to the vibrator for a second or two to release this dog from its pipe spacer. A coil spring around the locking screw aided this releasing operation.

To consolidate cinder concrete with this vibrator the concrete first was placed in the beam forms up to the level of the upper beam flanges and on the intermediate floor arch form to a depth of 2 or 3 in. Power then was applied to the machine for about 50 sec., which was the time required to obtain thorough consolidation. Because the machine vibrated two floor beams at one set-up, it was necessary to use it only on alternate panels. On this job, a crew of three men equipped with two vibrators and additional channel frames was able to keep up with the output of a 1-yd. mixing and hoisting plant. At times the work was carried on with only one vibrating machine.

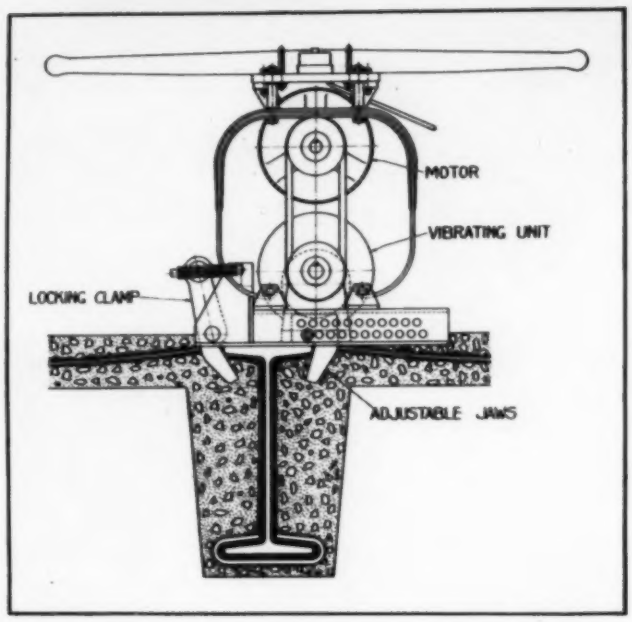
Three machines of the first type were operated at the post office. They were driven by 3-hp., three-phase, 220-440-v. electric motors of slightly varying speed ratings. One motor, a General Electric, operated at 3,440 r.p.m.; a second motor, made by the Imperial Electric Co., of Akron, Ohio, had a speed of 3,430 r.p.m., and the third, a LincWeld unit, rotated at 3,600 r.p.m. Flywheel speeds were equal to those of the motors.

Second Type of Vibrator—As a further development of the basic idea of beam vibration, the manufacturer designed a second type of vibrator to facilitate handling and to improve the operating characteristics of the machine. This second type consists of a vibrating head and a motor (mounted with spring suspension); both the motor and the vibrating unit are carried by a frame which incorporates clamps for attaching the machine directly to the structural member, without the use of any auxiliary supporting device.

Vibration is produced by an eccentric weight rotated at high speed about an axis parallel with the structural member to which the machine is clamped. The eccentric disk is made adjustable to permit varying the off-center weight to obtain a degree of vibration proportionate to the size and weight of the member vibrated.

Three points of attachment to the beam are provided to prevent skewing of the machine while in operation. The vibrator is attached to one side of the beam by two adjustable jaws, and the final locking in fixed position is accomplished by a screw clamp on the other side of the beam. These points of attachment form an isosceles triangle. The two adjustable clamps can be adjusted by ¼-in. increments to fit beam widths from 6 in. to 18 in. Two men pick up and move the machine by a long pole handle on top.

A 3-hp. three-phase, 220-440-v. Linc Weld electric motor operating at 3,600 r.p.m. powered the one vibrator of this type used at the Post Office. About 15 sec. operation was sufficient to consolidate the concrete fireproofing around one beam and the concrete on the adjacent floor arches. Because the machine vibrated only one beam, it was necessary that it be attached to each horizontal steel member. In spite of this fact, less time was required in carrying forward the operation with the new machine than with the older type.



VIBRATOR is attached to beam flange by two jaws on one side and by locking clamp on other. Jaws are adjustable for flange widths from 6 to 18 in. Motor, suspended from U-shaped leaf springs, drives vibrating unit by V cog belt.

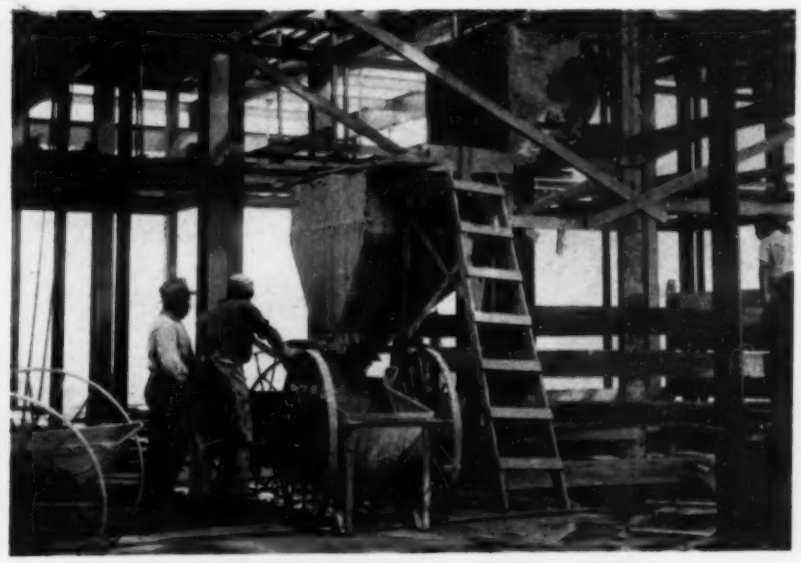
Concreting Procedure—Both columns and floor beams of the structural frame were completely fireproofed with cinder concrete, but the girders had cinder concrete fireproofing on the lower flanges only, with one-course brick protection on the webs, to save weight. The concrete fireproofing around the lower girder flanges was placed to a depth of 6 in. above the soffit forms. It was impossible to carry on this fireproofing of the girder flanges as part of the regular floor concreting operations, and the lower flanges of the girders with their connecting columns, therefore, were fireproofed in advance of the floor work. For vibrating the concrete around the lower flanges of the girders and in the column forms, the second-type machine, which was attached directly to the upper flanges of the girders, was found more effective than the first. This machine satisfactorily vibrated girders up to 4 ft. in depth, with two cover plates. It was thought at first that a special vibrator would be needed for the columns, but the success of the second-type machine in consolidating concrete in the column forms proved a special unit for this work unnecessary.

After the lower flanges of the girders and their connecting columns had been fireproofed, the concreting crews began the construction of floor arches and the fireproofing of floor beams, upper flanges of girders and any columns that had been omitted from the earlier operation. The cinder concrete first was dumped, without spreading or tamping, into the beam forms and for a partial depth on the flat arch forms, and the vibrator then was operated a sufficient length of time (15 sec. for the second-type machine) to consolidate the concrete, bond it to the structural and reinforcing steel, and assure a smooth finish on the exposed surfaces. After this process of placement and consolidation had proceeded for the desired distance, the crew placed without vibration the rest of the concrete required to bring the floor slab to grade. The two steps of floor concreting usually were held about four bays apart.

A 5-bag batch, yielding between 24 and 25 cu. ft. of concrete, was employed. By the original method of hand puddling a grout mixture had been necessary to fill the 2-in. space under the lower beam flanges where the flow of fireproofing concrete was obstructed by wire mesh reinforcement. When placing the concrete with the aid of vibrators, however, a drier mix was used. Vibration compacted the concrete appreciably and apparently increased its density.

Mixing and Hoisting Plants—Two 1-yd. mixing and hoisting plants, capable of producing a total of more than

EARLIER TYPE OF VIBRATOR, resting on channel frame attached by bolted clamps to upper flanges of two floor beams, vibrates both beams simultaneously. C. H. RAUSCHER, general foreman, observes operation.



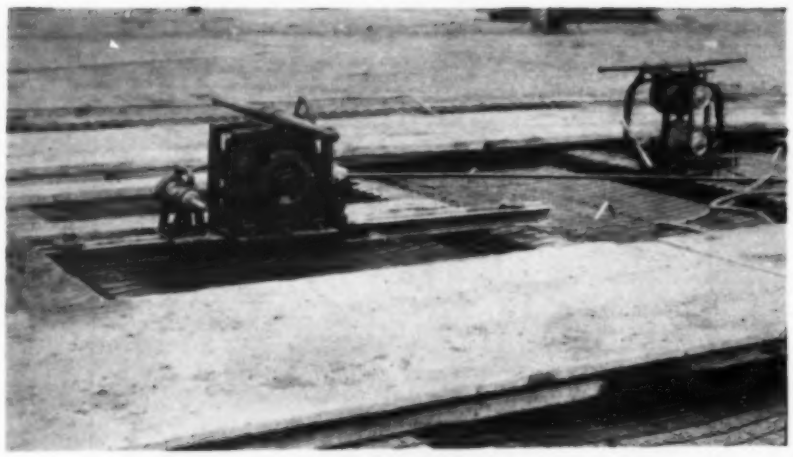
CONCRETE is hoisted from each of two mixing plants in tip-over bucket and is distributed on floor by hand carts.

600 yd. per 8-hr. day, were located adjacent to the streets on the south and west sides of the building, where trucks could deliver aggregates and cement. The trucks dumped aggregates into bins which discharged by gravity into batchers and mixers in the basement. Bag cement was unloaded into storage sheds on the first floor and was emptied by hand out of the bags into chutes which fed the charging hoppers of the mixers. Each plant was equipped with Blaw-Knox steel bins divided into two compartments holding 80 to 85 yd. of cinders (by means of a built-up timber extension around the top) and about 40 yd. of sand. The aggregates were batched by volume with Blaw-Knox equipment. Concrete at each plant was mixed by a Marsh-Capron 1-yd. mixer driven by a G.E. 25-hp. electric motor.

Each of the two mixers discharged into a 33-cu.ft. bucket operated at a speed of 500 ft. per minute by a Lambert single-drum hoist powered by a G.E. 125-hp. motor. The buckets delivered concrete to floor hoppers from which the material was drawn off and distributed in Lansing and Jackson hand carts with a water-level capacity of 7 cu.ft. The contractor left holes in the concrete floors for the hoists.

Saving in Labor—When running 500 to 600 yd. of cinder concrete per day a force of five men, one skilled mechanic and four laborers, took care of the vibrators. On the day when a representative of *Construction Methods* visited this work, the five men operated three vibrators part of the time and all four vibrators during the rest of the day. Before putting mechanical vibrators on the job, the contractor had been using 10 to 12 puddlers. In addition to the saving in labor on the concreting operation, the mechanical vibrators, by practically eliminating patching and by leaving a smoother surface for the finishers greatly reduced the cost of finishing.

Tests of Bond Strength—Tests were made at Purdue University under the direction of D. D. Ewing, professor of



TWO TYPES OF ELECTRIC VIBRATORS. Older type, in foreground, rests on supporting frame. New type, in background, is attached directly to steel beam.

electrical and railway engineering, to determine the effect of vibration on the bonding strength of concrete to steel. Three series of tests were made, with two specimens in each series. One series tested plain, hand-tamped concrete; in the second series, the forms were vibrated; and in the third, vibration was applied to the steel rod in the concrete.

Test specimens consisted of concrete blocks 7 in. wide by 10 in. long by 10 in. high with a 1-in. square steel bar embedded in horizontal position in the middle of each block, giving a 7-in. length of contact between steel and concrete and 28 sq.in. of bond area. The bars were 14 in. long, with machined ends. They were thoroughly cleaned with naphtha before being installed in the concrete. The concrete was 1:2:3 mixture, metered by weight, with a slump of 6 in.

RESULTS OF TESTS
BOND STRENGTHS OF
CONCRETE TO STEEL

Series	Specimen	Max. pushing load, lb.	Bond area, sq. in.	Bond strength, lb. per sq. in.	Bond strength, per cent
I	A	4,300	28	153	
(Plain)	B	4,800	28	171	
Average		4,550	28	162	100
II	A	7,600	28	271	
(Form vibrated)	B	7,410	28	265	
Average		7,505	28	268	165
III	A	10,200	28	364	
(Rod vibrated)	B	9,600	28	343	
Average		9,900	28	353	218

Specimens in Series I correspond to hand-tamped concrete. In casting the specimens of Series II, the forms were vibrated 3 min.; and in Series III, the rod was vibrated 3 min. After 24 hr., the specimens were removed from the forms and placed in a curing room with moisture-saturated air maintained at a constant temperature of 70 deg. F. The specimens were removed from the curing room 36 hr. before testing and were kept in the air of the laboratory. Tests were made at the age of 14 days, with the results given in the table.

Supervision—James L. Carey, president of the Wallin Concrete Corp., was instrumental in introducing the new type of vibrator on the Philadelphia Post-Office work. A. B. Wallin, vice-president and general manager, cooperated with the engineers of the manufacturer in adapting the vibrator to the construction requirements of the building. C. H. Rauscher was general foreman, and V. Lomuller was job engineer. For the Treasury Department, under James A. Wetmore, supervising architect, operations are directed by Walter I. Gideon, construction engineer. Grover L. Adams, superintendent, is in charge of the project for the general contractor, Starrett Bros. & Eken, Inc.

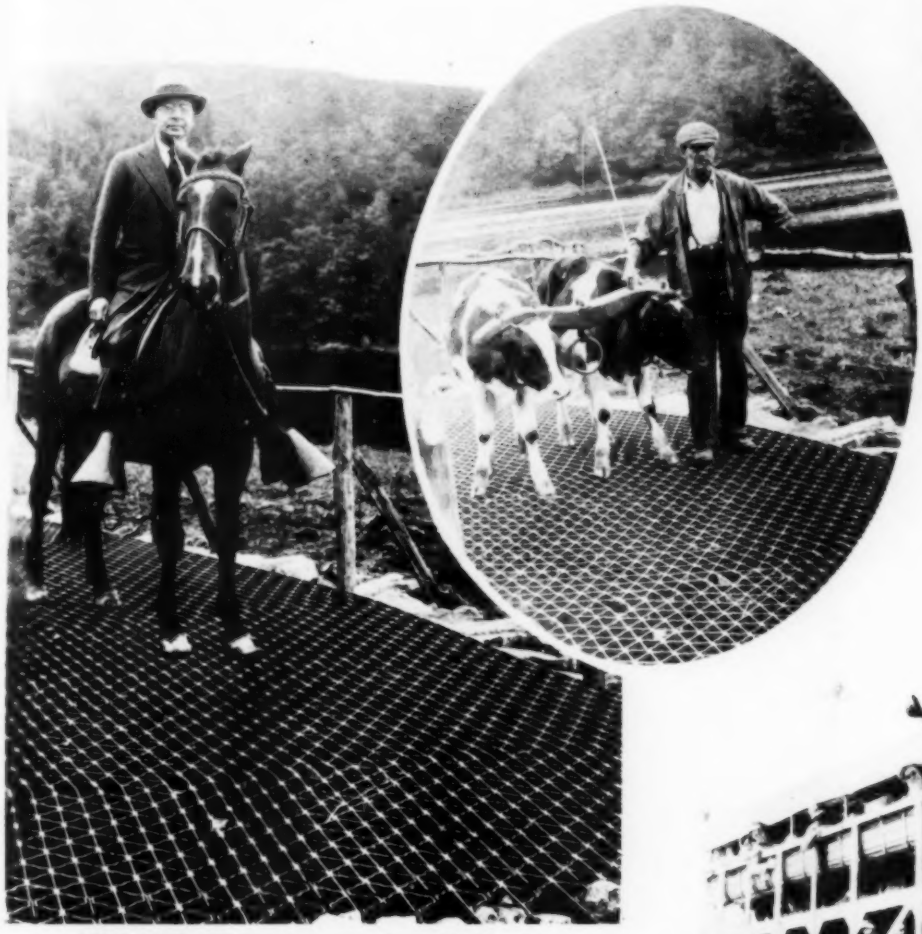
A. B. WALLIN *(below)*, vice-president and general manager, supervises work for Wallin Concrete Corp.

EXPOSED SURFACES of floor arches and fireproofing, untouched by finishers, reveal dense, smooth finish requiring only light rubbing.

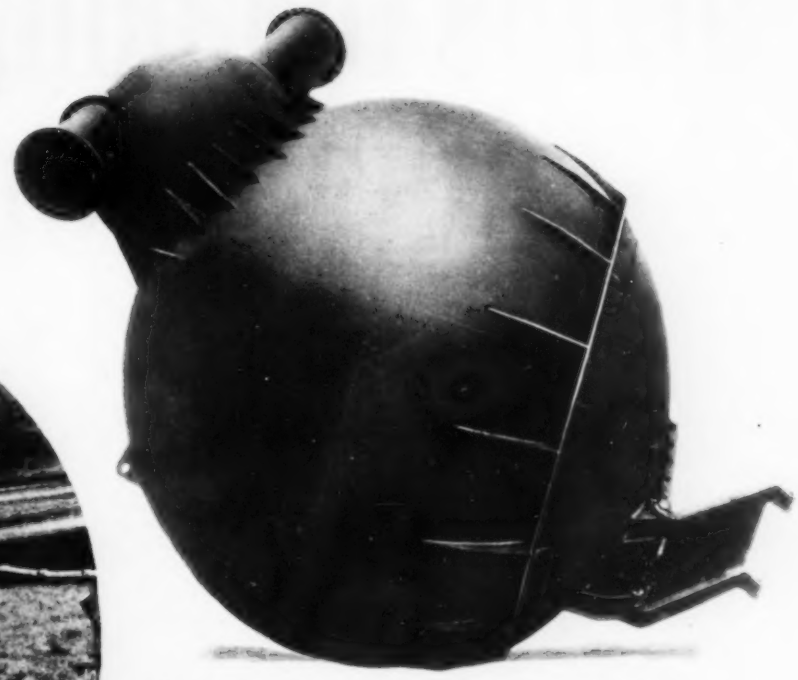
TYPICAL FORM CONSTRUCTION for beams and floor arches. Forms, which are supported by hangers from beams, are wrecked and reassembled for each floor.

JOB ODDITIES

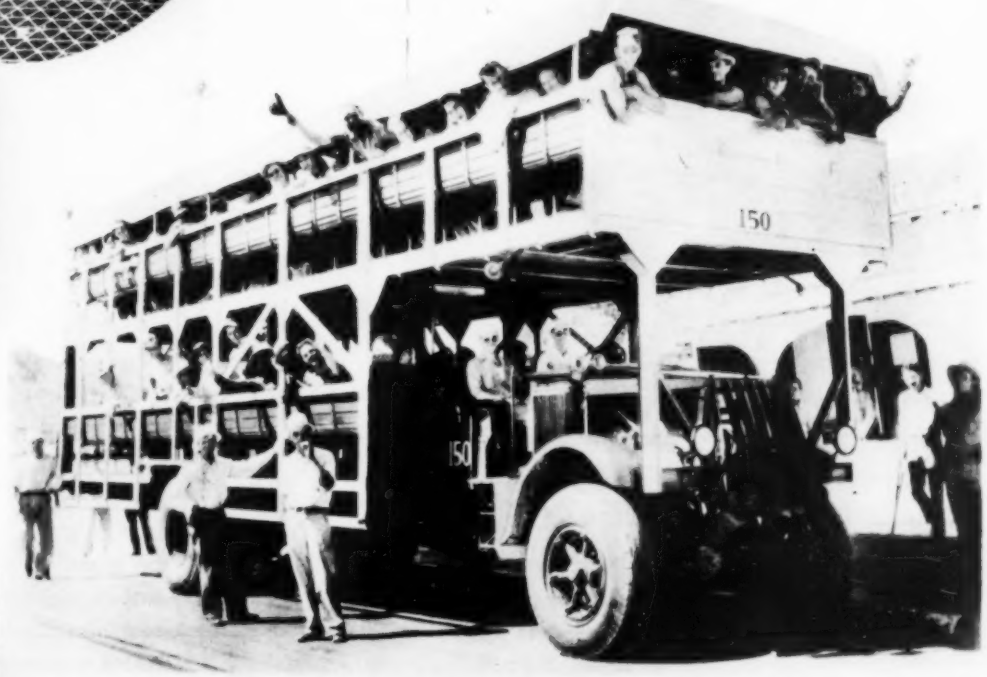
A Monthly Page of Unusual Features of Construction



ANIMAL REACTION to open-mesh steel bridge flooring of same design as Irving decking installed on reconstructed University Bridge in Seattle (see *Construction Methods*, July, 1933, pp. 26-29) is tested on small bridge at Kent, Conn. Cattle and horses crossed the steel decking willingly, without any signs of balking or nervousness. The rider of the horse in the photograph at the left, Dr. D. B. Steinman, consulting bridge engineer, of New York, appears just as much at ease as his mount in crossing the open decking.



BOULDER TRAP of arc-welded steel construction has been completed for use on suction line of sea-going dredge to operate at Cape Cod Canal, Massachusetts. Trap door at bottom of 18-ft. diameter sphere opens through hull to discharge accumulated debris directly into ocean . Smaller sphere 5 ft. in diameter at top, acting as intake and outlet attachment for dredge line, is equipped with a grizzly to intercept boulders which might damage dredge pump. Shell plates of 18-ton sphere, 1¼ in. thick, were assembled by welding with Lincoln shielded-arc equipment.

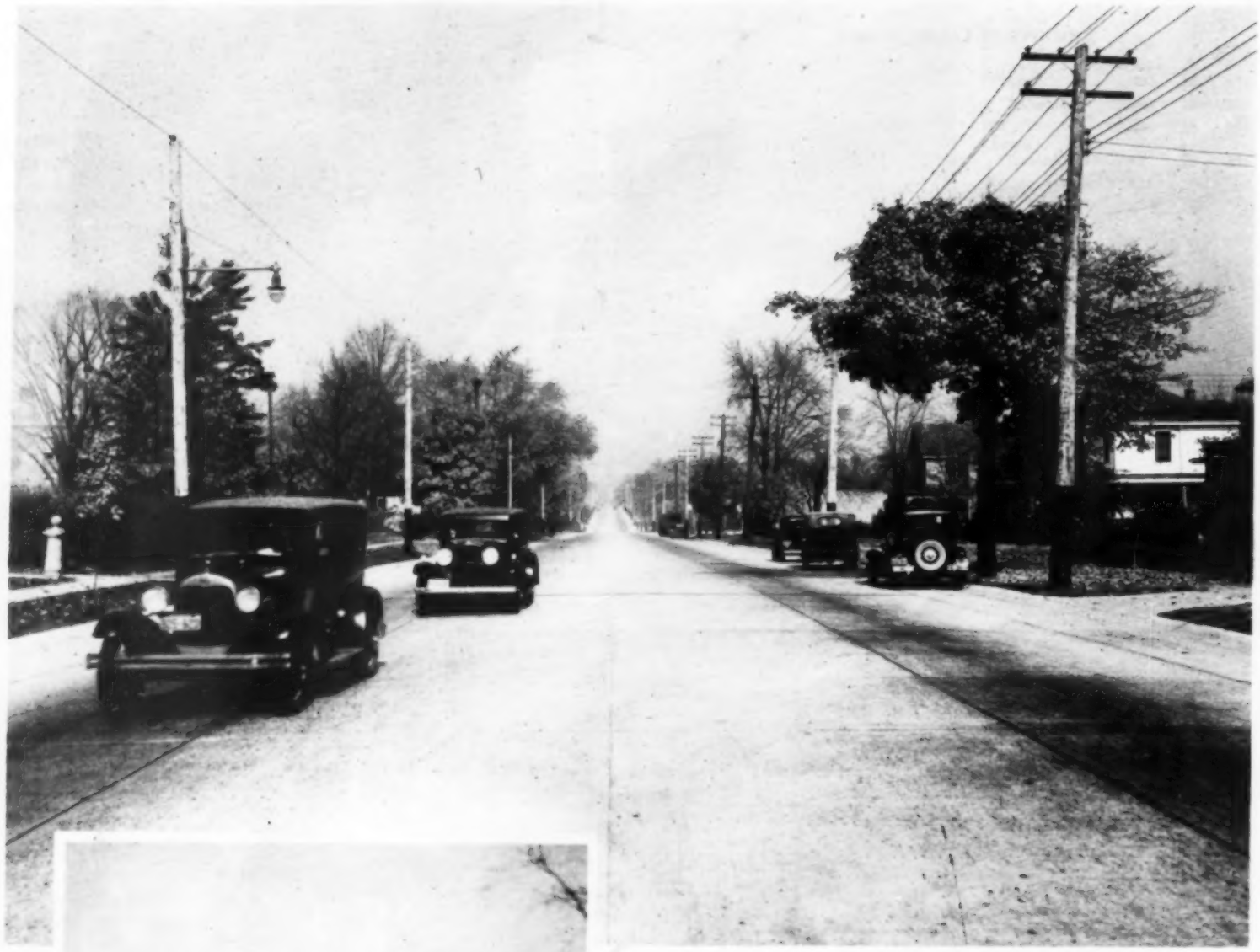


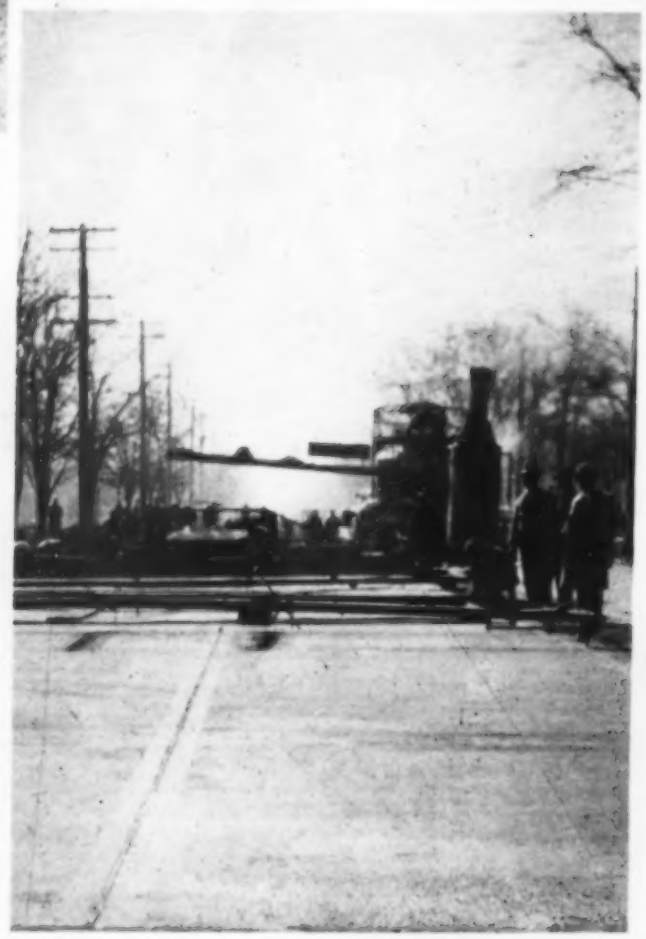
SUPER-BUS, accommodating 150 men, transports members of construction crew of Six Companies Inc. to and from work at Boulder dam on Colorado River. Mack truck chassis has wheel base of 260 in., is 10 ft. wide, with double-deck body 15½ ft. high. Each deck carries four longitudinal rows of seats. Prior to conversion into a bus the truck, equipped with a 16-cu. yd. body, had hauled earth and rock excavation from the damsite.

WOMAN POWER *(left)* is means of operating this roller during repair of street in Hong Kong. Oriental maidens tug at ropes while male superintendent strolls behind, guiding course of heavy cylinder. Clever, these Chinese!

J. Jay Hirz Photo

$400,000,000 HIGHWAY





PAVEMENT-LAYING THROUGHOUT THE WINTER

Last Winter, as an employment relief measure, 1¾ miles of the main street of Wyoming, Ohio, was repaved. Work proceeded right through the Winter. To retain heat, concrete was immediately protected with burlap and straw. When 65-degree concrete was placed at 35 degrees atmospheric temperature, a thermometer placed next morning under the covering showed 60 degrees, when outside temperature had dropped to 20 degrees or less during the night. In all cases, ample strengths were obtained in 48 hours to open the pavement to traffic despite weather conditions.

Note the effect upon employment: For paving, 660 men were employed during five winter months; 14 more men were employed for a month by two local gravel producers. Paving started three supplementary operations,—relocating sub-structures, laying a stormwater sewer and lowering a gas main. It also took labor to produce and transport the other materials used. All told, more than 800 men found employment as a result of this job. Here is the wherewithal of business revival—a practical demonstration on a small scale of the tremendous possibilities of the PWA re-employment program.

PROGRAM BIGGEST FACTOR IN QUICK JOB RELIEF

Range of Winter Construction Greatly Widened by High-Early-Strength Cement ...48-Hour Heat Protection Cuts Costs

ROADWORK used to taper off as nights got cold and days grew shorter. Concrete could only be placed during the warmer hours; if poured after say two o'clock, it would not harden, could not be finished until late at night.

So, as winter approached, the paving day became shorter and shorter, payroll hours grew steadily less.

Now all that is changed. The dependable high-early-strength of 'Incor' Cement does away with long Winter curing delays. Heat 'Incor' Concrete (60° to 80°, according to conditions); retain this heat for 48 hours, and the concrete is ready to use. Risk of frost damage practically eliminated. Winter schedules simplified all along the line.

The range of Winter work is greatly widened. Unfinished projects can be readily closed out. In many localities, pavement-laying can be carried on all Winter, except of course in heavy rain or snow. Thus, not only structures and grading, but in many cases complete roadbuilding projects can be continued right through the Winter.

This makes it easily possible to convert a large part of the $400,000,000 PWA roadbuilding program into wages this Winter. Here is one place where the so-called "capital industries" can be speeded up, to get men off of doles and on to payrolls without a day's unnecessary delay.

SIX VITAL ADVANTAGES

'Incor' Cement brings a new era in winter construction; its dependable high early strength assures six vital advantages:

1. **Concrete ready to use after 48 hours heat-curing.**
2. **Heating and protection costs reduced 60% to 80%.**
3. **Form re-use in two to three days.**
4. **Cold-wave and storm hazard minimized.**
5. **Summer schedules made possible in winter weather.**
6. **Uninterrupted employment for construction labor.**

Lone Star Cement Co. Alabama.....Birmingham
Lone Star Cement Co. Indiana, Inc.....Indianapolis
The Lone Star Cement Co. (Kansas).....Kansas City, Mo.
Lone Star Cement Co. Louisiana.....New Orleans
Lone Star Cement Co. N. Y., Inc.....New York—Albany
Lone Star Cement Co. Pennsylvania..... Nazareth, Pa.
Lone Star Cement Co. Texas.....Dallas—Houston
Lone Star Cement Co. Virginia, Inc.....Norfolk

'INCOR' 24-Hour Cement

PROVEN BY 6 YEARS' USE

'INCOR' is made by the producers of Lone Star Cement, subsidiaries of International Cement Corporation, under Patent Nos. 1,700,032 & 1,700,033

DREDGING AND FILLING for Montrose boat harbor at Chicago's Lincoln Park extension. Interlocking sheetpiling forms bulkhead along inner line of basin.
Chicago Aerial Survey Photo

Seven Hopper Dredges Add 259 Acres of Fill to Chicago's Lake Front

Part II

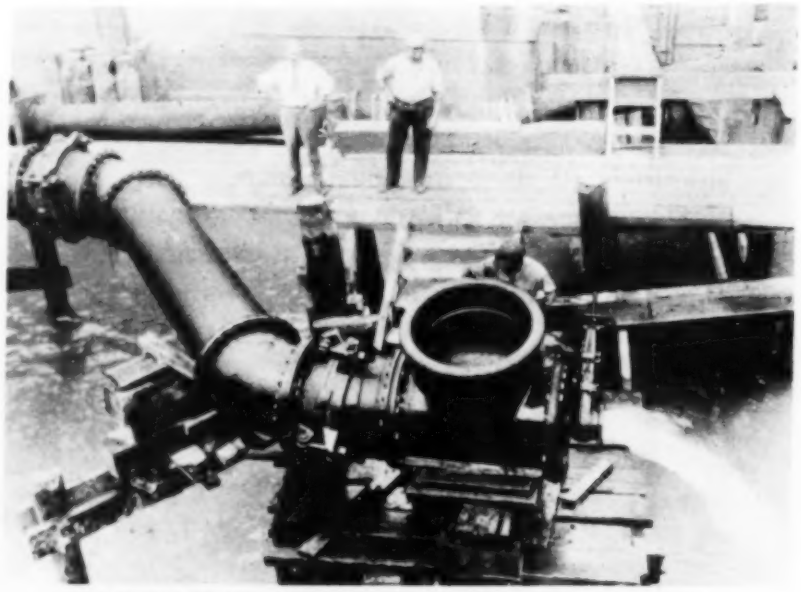
[This second and concluding installment continues the description of the hopper dredge, "J. R. Sensibar", and adds details of bulkhead construction at Lincoln Park, Chicago.]

Dredge pumps — Two centrifugal pumps (30-in. suction, 28-in. discharge), of Worthington manufacture, are installed in the engine room. Tandem 750-hp. Westinghouse motors on one shaft drive each of these pumps. The motors are so connected that the second automatically cuts in when the load on the first exceeds 750 hp., thus assuring economical operation. When necessary, the motors can provide 2,460 hp. For maximum heads and long discharge-line operation the two pumps are connected in series, developing more than 3,000 hp. with a discharge pressure of about 110 lb. per square inch. With this hook-up "J. R. Sensibar" can pump through a discharge line 4 mi. in length. The pump motors derive their power from the main turbine —generator unit and, accordingly, are designed for 2,300-v. 50-cycle current.

Suction Intake—Each pump is connected by a 30-in. pipe to an intake port in the side of the ship. A special arrangement provides for raising and lowering the overboard suction pipe. By this arrangement the overboard pipe can be lifted and hung clear of piers and pile clusters. As illustrated by one of the photographs, the elbow connecting the overboard pipe to the intake is attached to a square plate which travels in a grooved vertical track on the side of the ship. The suction pipe is connected to this elbow by a swivel joint. Two A-frame derricks raise and lower the entire overboard suction line.

Special hoods are provided for the lower end of the suction pipe. One type is used when the dredge is sucking sand from a deep deposit, where the ship can be anchored in one place while taking on a load. A second type is employed in dredging shallow sand where the ship must keep in motion while the cargo is being loaded.

Discharge Pipe—A 28-in. discharge pipe from each pump extends up through the deck and terminates in a swivel elbow. One of the photographs shows the pipe connection from this swivel elbow to the shore pipe line. The swivel elbow and double swivel joints at the connection to the shore pipe provide a flexible coupling to take care of changes in level and pitching and rolling motion of the ship at the pier. A boom hoist lifts the connection above the level of the ship deck after the dredge has discharged its load.



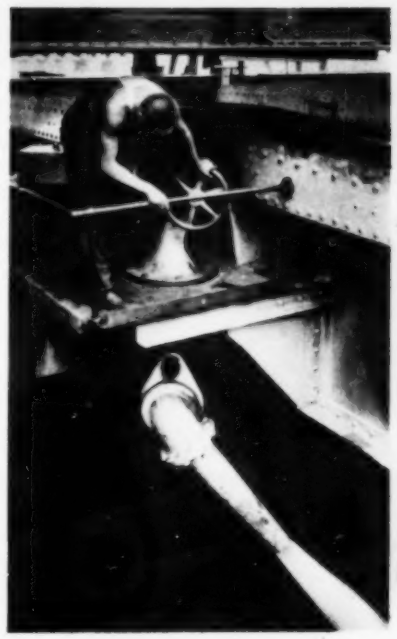
DRAINING SHORE LINE after discharge pipe has been disconnected.

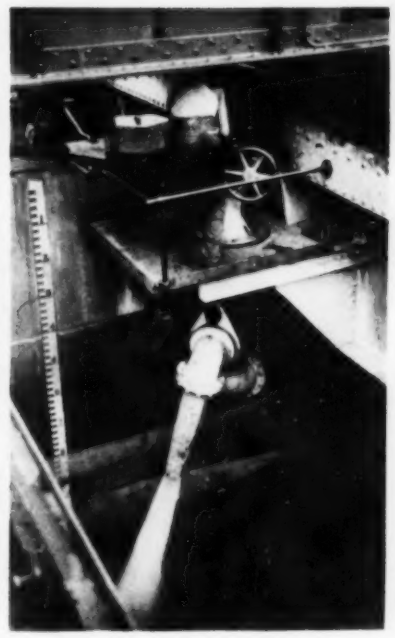
DISCHARGE PIPE and shore line connection are raised clear of dredge boat deck by boom hoist.

CARL NELSON *(left, below)*, construction superintendent, and **CAPT. WILLIAM A. MURPHY** (since deceased), general superintendent, Great Lakes Dredge & Dock Co.

Valve Control — Flow of material through the intake and discharge pipes is regulated by a total of 27 valves. All these valves are electric-motor-driven and are equipped with Cutler-Hammer motor control units. The motor control units are connected to central push-button control panels, one in the engine room and one on the deck aft of the cargo hold. Above each of the two control panels is a diagram of the pipe layout equipped with a red and a green electric light at the location of each valve to indicate whether the valve is closed or open. The operator can see at a glance the whole story of the flow of material.

Loading Operation—When dredging sand for the Lincoln Park extension, "J. R. Sensibar" anchored 2 or 3 mi. off Indiana Harbor and lowered both suction pipes. Each pump delivered its mixture of sand and water containing about 20 per cent solids to one of the long flumes running lengthwise of the ship. From the flumes, the sand and water were discharged through the classifying screen gates into the hoppers. Spillways carried away the excess water from the hoppers over the ship's side, successive spillway gates being closed as filling of the hoppers progressed.





NOZZLE, controlled by hand-operated wheel above directs pressure jet of water against surface of sand in hold when ship is unloading wet.

During filling and on the trip back to Lincoln Park, moisture in the sand drained through the screen panels into a long flume below the hoppers extending to the engine room where a 16-in. centrifugal pump discharged the water overboard.

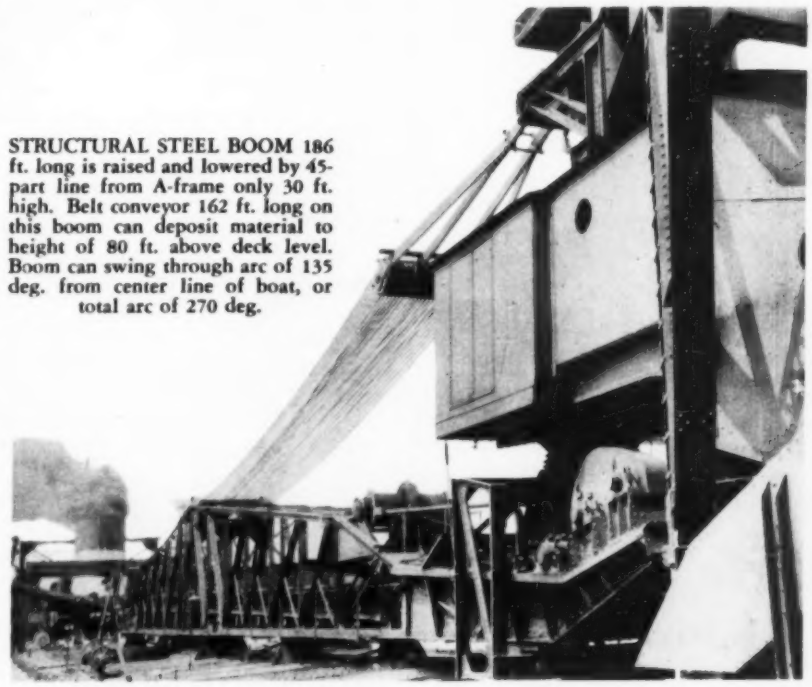
Unloading Procedure — After tying up at the pier at Lincoln Park, the discharge pipe on one side of the ship was connected to the shore pipe line. A series of nozzles under the hatch covers directed powerful jets of water against the surface of the sand, washing it into the vertical wells already mentioned. Two Worthington 12-in. centrifugal pumps supplied 10,000 gal. per minute to the nozzles. The upper gates of the well were opened first, and as unloading proceeded, the lower gates were opened in turn. As 10,000 gal. per minute was not sufficient for pumping the material ashore, additional lake water was admitted through a long flume feeding the eight wells.

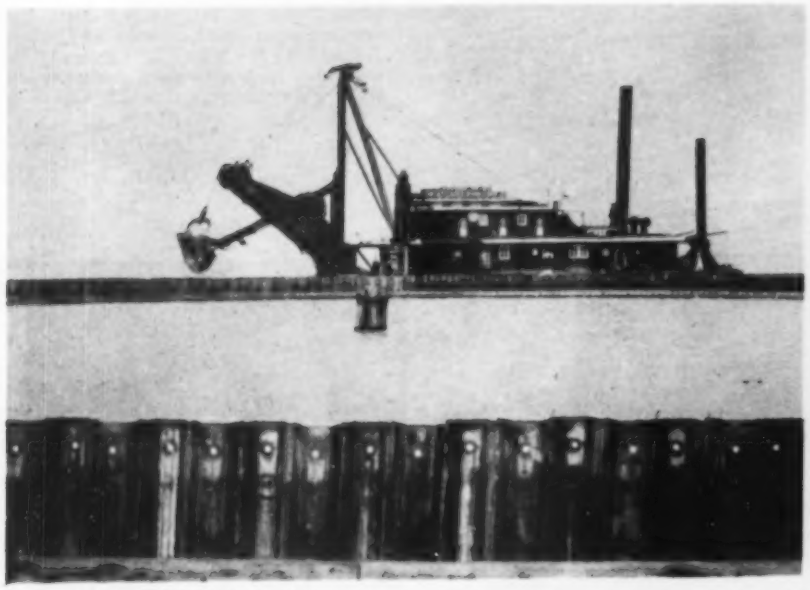
Unloading Dry Cargo—One of the most interesting features of the ship's equipment, which of course was not used at the Lincoln Park extension, is the dry cargo unloading system, which consists essentially of a series of belt conveyors. Under each of the parallel hoppers is a 48-in. belt conveyor running the full length of the cargo hold. These conveyors deliver to two transverse conveyors at the end of the cargo hold which transfer the material to a 60-in. inclined belt.

The inclined belt feeds a 60-in. boom belt which carries the material

F. R. GERHARDT *(left)*, construction superintendent, Construction Materials Corp., and R. A. BRINKMAN, general superintendent.

STRUCTURAL STEEL BOOM 186 ft. long is raised and lowered by 45-part line from A-frame only 30 ft. high. Belt conveyor 162 ft. long on this boom can deposit material to height of 80 ft. above deck level. Boom can swing through arc of 135 deg. from center line of boat, or total arc of 270 deg.





DIPPER DREDGE transfers quarry run stone from outside bottom dump to jetty.

SAND AND WATER SPRAY is discharged into hopper of dredge boat from flume under deck.

over the side of the ship. This belt is 162 ft. long between pulley centers, and the boom itself has an overall length of 182 ft. The boom can swing through an arc of 135 deg. from the center line of the ship, or through a total arc of 270 deg., and can be raised to deliver material from the end of the belt at a height 80 ft. above the level of the ship's deck. Speed of the belt in the tunnels under the cargo hoppers is about 450 ft. per minute, and of the boom conveyor is about 650 ft. per minute. When operating at maximum capacity, the conveyor system can discharge 4,500 tons an hour. All the conveyors are driven by Westinghouse electric motors controlled from the deck.

Capt. H. F. BRINKER of "J. R. Sensibar" in pilot house, with one hand on remote control system for propulsion motors.

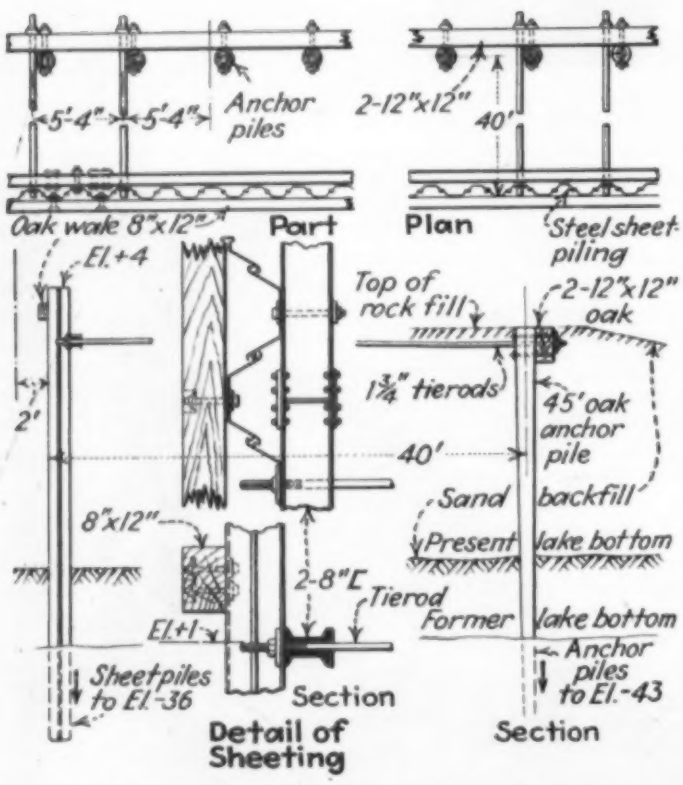
Special construction at the A-frame support was required to permit the large swinging range of the boom. The anchor pin of the tackle block at the A-frame is carried by an extension from the A-frame. The back legs of the A-frame, which is only 30 ft. high, are anchored to an arch construction below deck, and the ship frame providing the foundation is adequately strengthened by additional structural members. A 50-hp. hoist motor, mounted on the boom itself near the tail end, swings and raises the boom. The apparatus for raising and lowering the boom consists of a 21-sheave head block and a 22-sheave tail block, carrying 3,340 ft. of American Steel & Wire Co. ⅞-in. wire rope.

Pilot House Control — In the pilot house, as elsewhere, the ship is completely equipped with the most modern devices. Of particular interest is the remote control system by which the propulsion motors can be started and regulated from the pilot house as well as from the engine room.

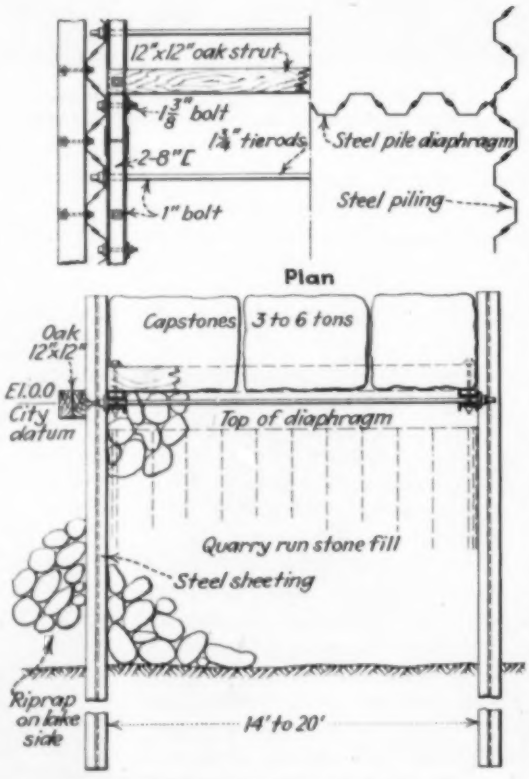
Additional equipment, such as condensers, pumps, lighting plant, and auxiliary and emergency units, as well as excellent quarters for the officers and crew, are provided.

Steel Sheetpile Bulkheads — Older types of wood-pile bulkheads used on the Great Lakes had the serious disadvantage that they permitted stone fill between the bulkhead walls and sand fill behind the bulkhead to escape between the piles, especially in stormy weather, eventually causing settlement of the fill and weakening of the structure. The tight walls of steel sheetpile bulkheads prevent this loss of material.

The first steelpile bulkhead constructed at the Lincoln Park extension consisted of two lines of Inland arch-web interlocking steel sheetpiling with spacing between them varying from 14 ft. in water 10 to 12 ft. deep to 20 ft. in depths of 20 to 23 ft. The length of



FOR BOAT HARBOR BULKHEAD single line of steel sheeting is anchored to wood piles.



FOR DEEP WATER END of filled area bulkhead is formed by two lines of sheetpiling and rock fill.

sheetpile wall is reinforced on the land side with a pair of steel channels and is protected on the harbor side with an 8x12 in. oak buffer timber.

Administration — Hugh E. Young, consulting engineer for the Commissioners of Lincoln Park, planned and directed the extension project, with E. H. Haug in charge of design and W. K. Cook in charge of construction.

J. R. Sensibar is president of the Construction Materials Corp., and R. A. Brinkman is general superintendent. Operations at Lincoln Park were directed by F. R. Gerhardt, superintendent.

The Great Lakes Dredge & Dock Co. was contractor for the double-walled bulkhead. For this company, Captain William A. Murphy, since deceased, was general superintendent, and Carl Nelson was construction superintendent. The single line bulkhead around the boat harbor was constructed by the Fitzsimons & Connell Dredge & Dock Co., which also had the contract for the dredging and sand filling at the boat harbor.

OAK WALE *(left)*, 8x12in., for bulkhead sheeting is bored for 1-in. bolts by air-driven tool.

BREAKWATER is formed by double line of sheetpiling with rock fill in between. Cap stones weighing 3 to 6 tons produce level surface on top of structure.

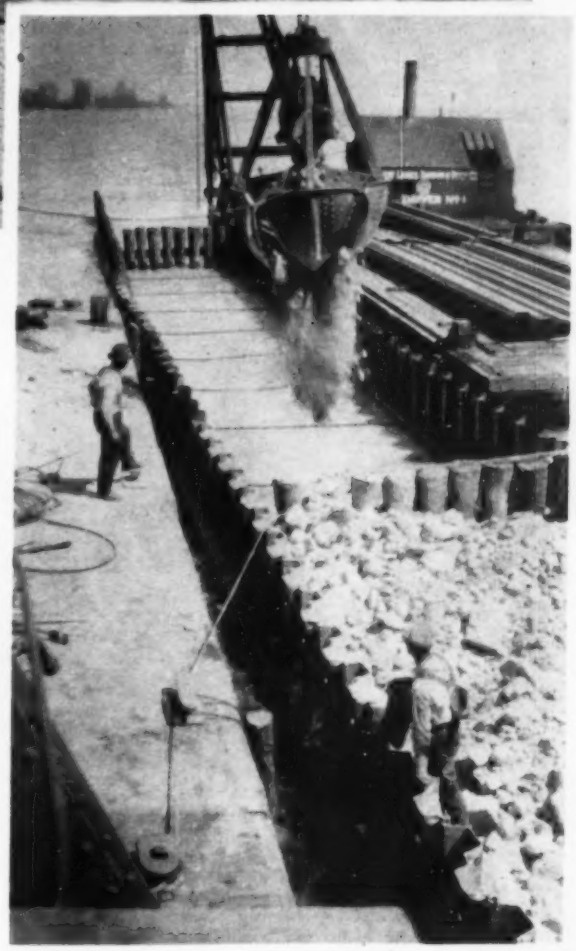
the piles was 40 ft. in the shallower parts and 42 ft. in the deeper water.

The sheeting was driven to an elevation 4 ft. above mean lake level, and each line was reinforced with an 8x12-in. oak wale on the outside and inside. At every fourth pile, the walls were tied together with wrought-iron tierods passing through the four wales. Transverse bulkheads of untreated oak piles were driven between the lines of sheeting at intervals of about 100 ft.

This type of bulkhead had the weakness that destruction of the outer wale would be damaging to the structure. A second type was designed, therefore, with structural wales made up of two steel channels back to back on the inside of each line of sheeting. A 12x12-in oak timber is provided on the outside of the bulkhead to act as a buffer, but this timber was bolted only to the outer sheet piles. Transverse partitions in this type bulkhead, spaced 75 ft. apart, consist of interlocking arch-web piles connected to the bulkhead walls by means of T-section piles. Wrought-iron tierods were used to connect the walls as before, these tierods passing between the two channels composing each wale.

Fill for the bulkheads was quarry-run stone placed by derrick boats with grab buckets. Workmen leveled this stone by hand, and derrick boats then placed large cap stones weighing 3 to 6 tons each. The finished surface of the bulkhead was approximately 4 in. above the sheetpiling.

Around Montrose boat harbor, where wave action is not a serious consideration, the engineers adopted a single line of interlocking steel sheetpiling, tied back at intervals of 5 ft. 4 in. by tierods 40 ft. long to anchor timbers behind a row of 45 ft. wood piles. The

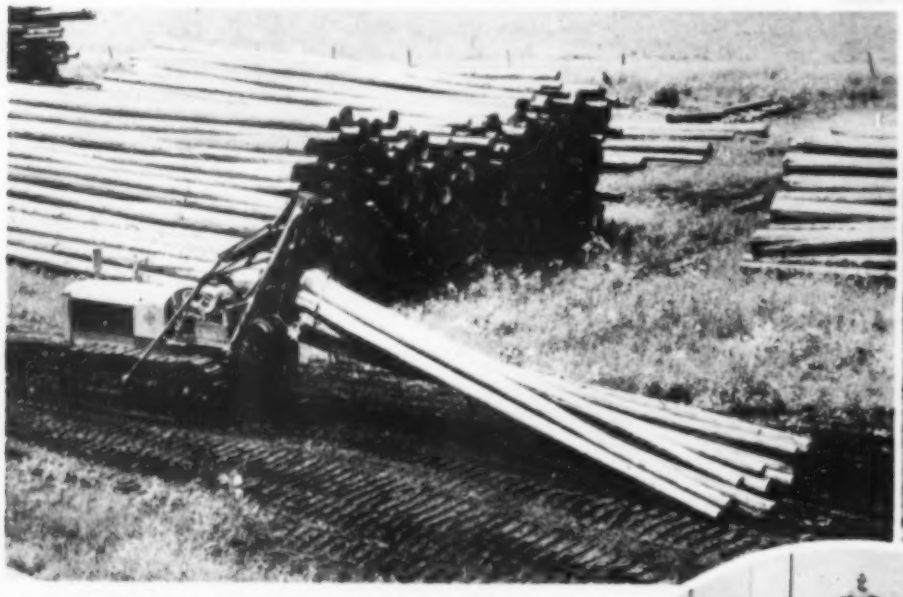


FIRST TYPE OF STEEL SHEETPILE BULKHEAD *(right)*. Floating derrick fills bulkhead with quarry-run stone from deck scow. Double lines of arch-web steel sheeting are reinforced on both sides with oak wales and are tied together with wrought-iron tierods passing through all four timber wales. Partitions approximately 100 ft. apart are constructed of closely driven wood piles.

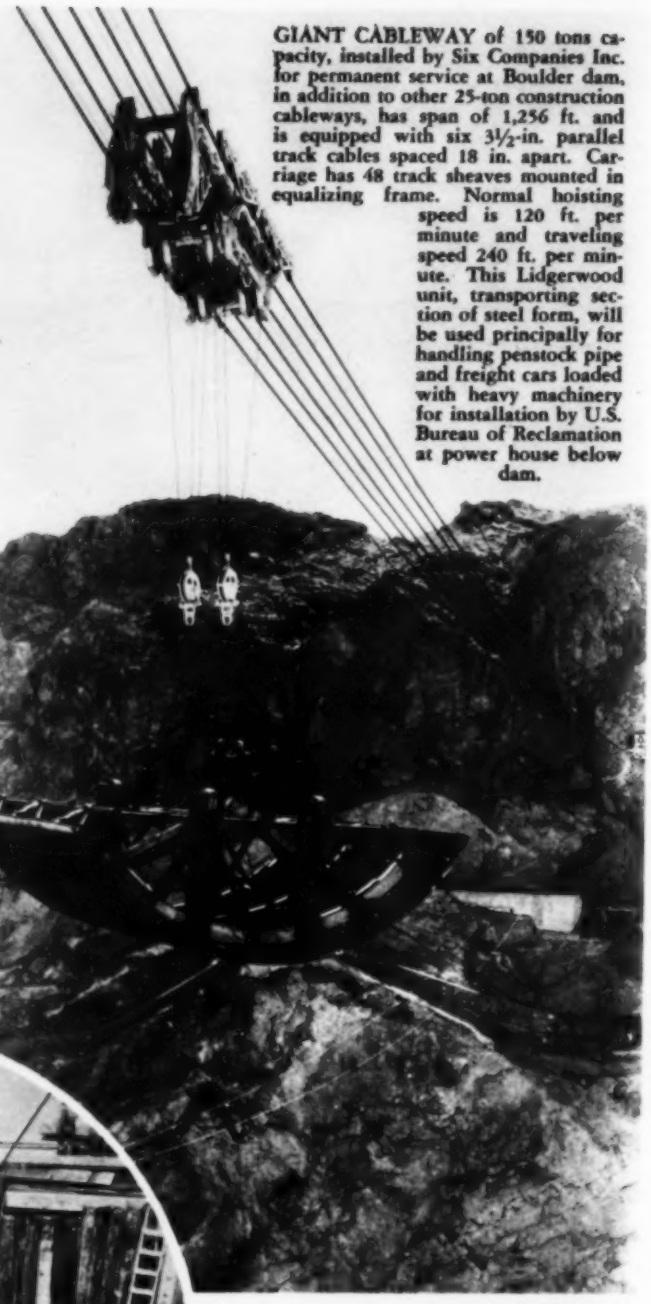
Getting Down to

DETAILS

[Close-up Shots of Job Methods and Equipment]

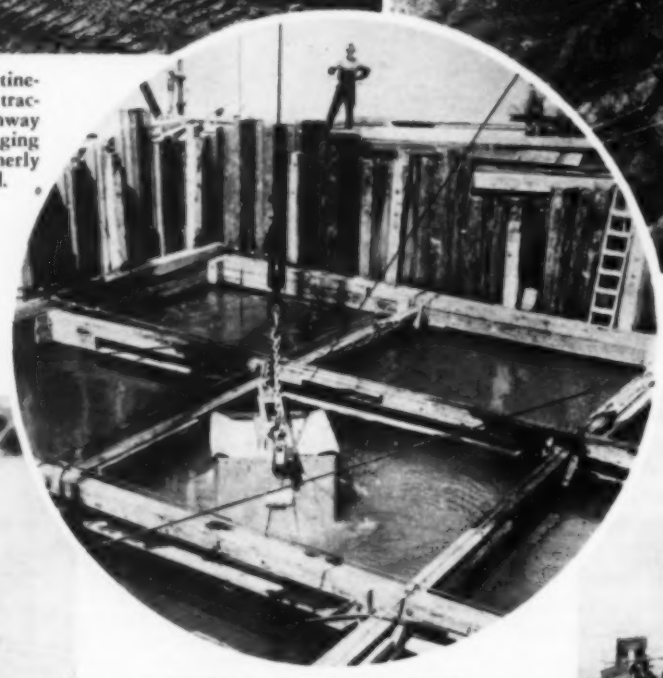


POLE-HANDLING OUTFIT, operated by Valentine-Clark Co., St. Paul, Minn., consists of Allis-Chalmers tractor equipped with special boom developed by Highway Trailer Co. to perform service similar to that of a logging arch. Machine illustrated replaced four teams formerly used on this work in company's telegraph pole yard.



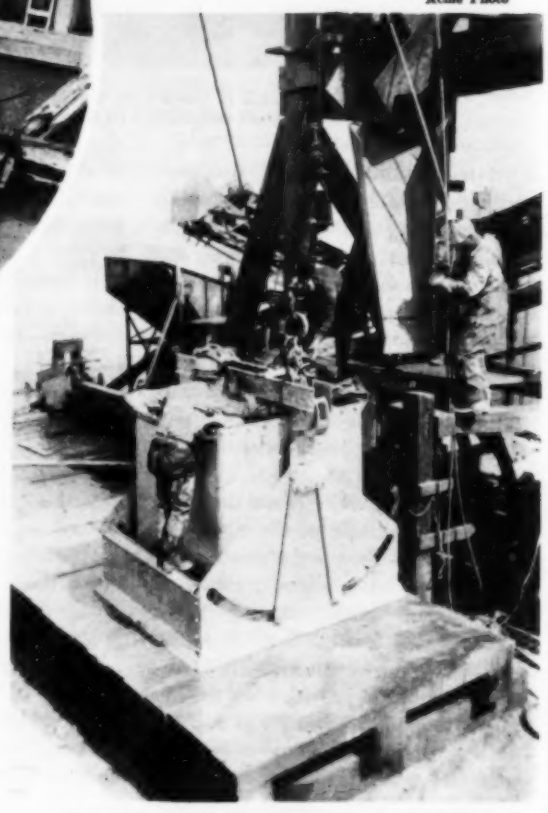
GIANT CABLEWAY of 150 tons capacity, installed by Six Companies Inc. for permanent service at Boulder dam, in addition to other 25-ton construction cableways, has span of 1,256 ft. and is equipped with six 3½-in. parallel track cables spaced 18 in. apart. Carriage has 48 track sheaves mounted in equalizing frame. Normal hoisting speed is 120 ft. per minute and traveling speed 240 ft. per minute. This Lidgerwood unit, transporting section of steel form, will be used principally for handling penstock pipe and freight cars loaded with heavy machinery for installation by U.S. Bureau of Reclamation at power house below dam.

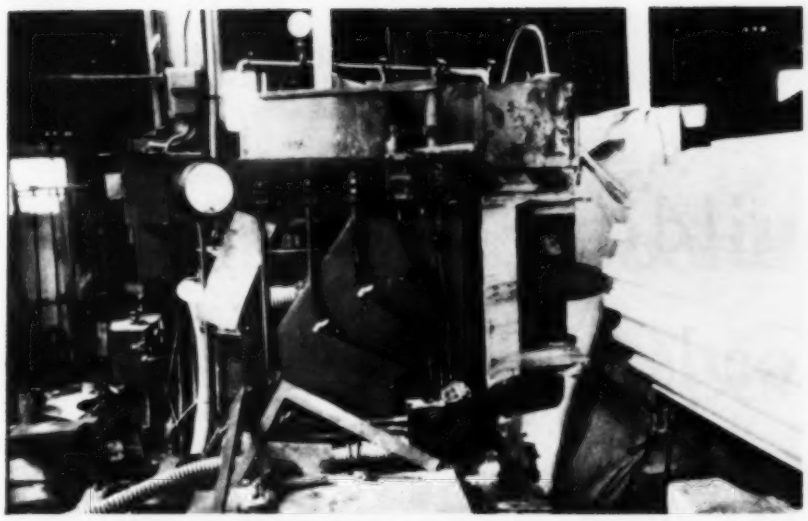
RADIO-TELEPHONES of ultra-high frequency are being used as a means of rapid communication between points of construction activity on the San Francisco-Oakland Bay bridge in California. D. Reginald Tibbets *(above)* University of California senior electrical engineering student, devised and installed the radio-telephone system linking field offices, derrick boats, launches, docks and pier sites.

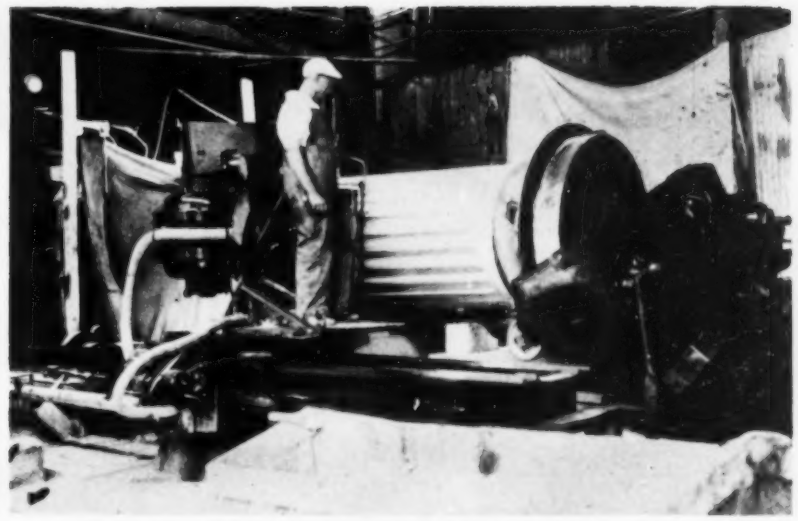


SUBMARINE CONCRETING for foundation of pier No. 2, to support tower for west suspension span of San Francisco-Oakland Bay bridge, is done with 4-yd. bottom-dump bucket *(right)* which is lowered 90 ft. through water to reach rock. Canvas flap *(above)* over top of bucket protects concrete. Before descent to bottom, bucket is held just below surface momentarily until water fills it, thus preventing concrete from being washed out during downward trip.

Acme Photo

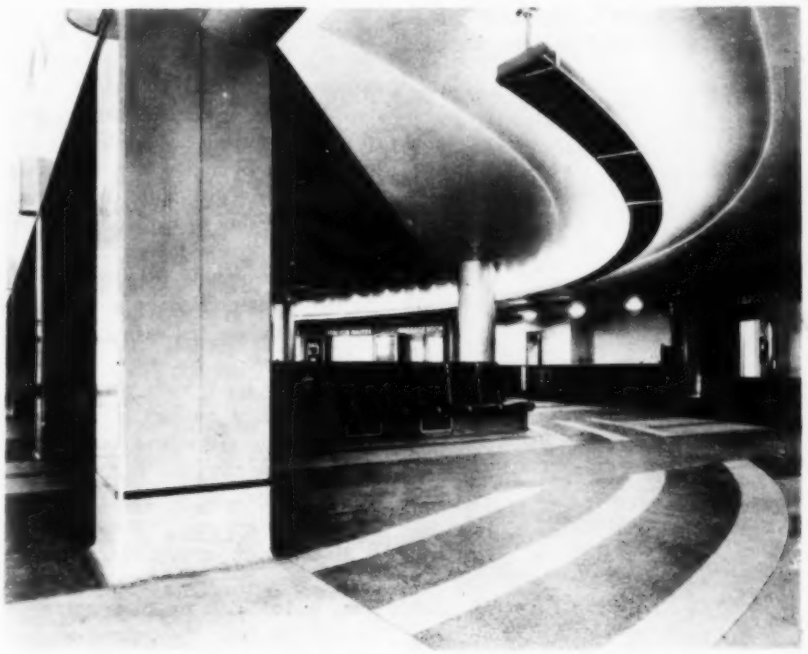






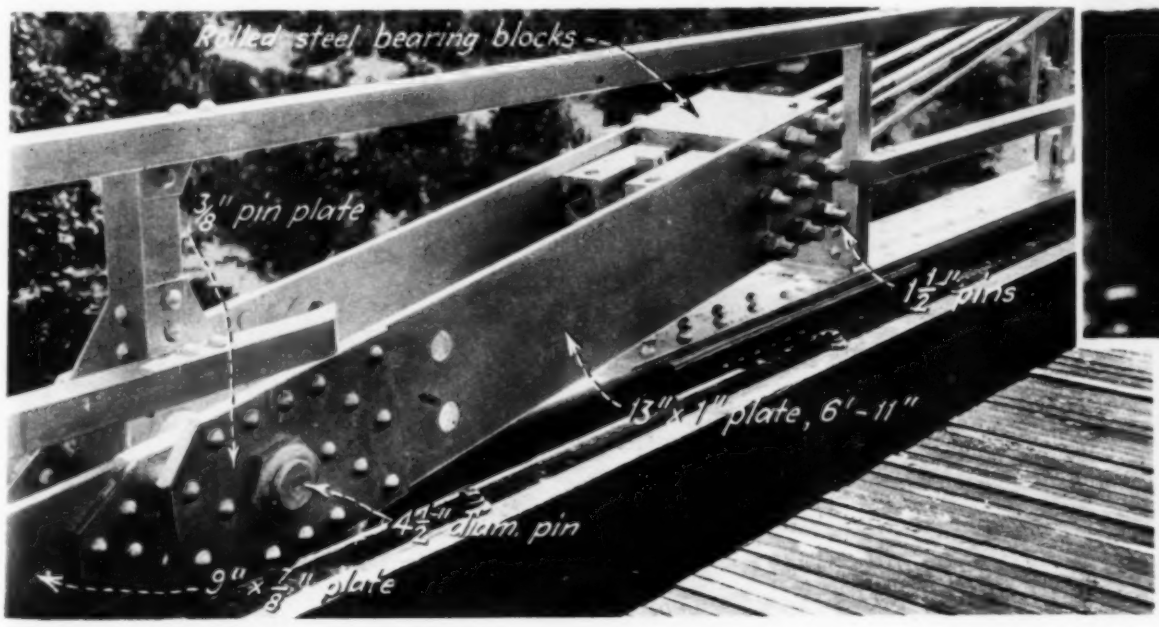
TO MACHINE FLUTED MARBLE COLUMNS, James McLaren & Sons, Inc., stone contractor on Dime Savings Bank, Brooklyn, (see *Construction Methods* for October, p. 31) uses rapid grinder lathe built by Willard F. Meyers Machine Co., Inc., of Long Island City, N. Y. Column sections are 6½ ft. long by 4 ft. in diameter. Machine first reduces drum to 4-ft. diameter with series of carborundum blades mounted on vertical arbor, or shaft, and then finishes to exact dimensions with flat wheel. For roughing out flutes, arbor is changed to one carrying series of carborundum blades, and flutes finally are finished with fluting wheel having semi-circular cross-section at periphery.

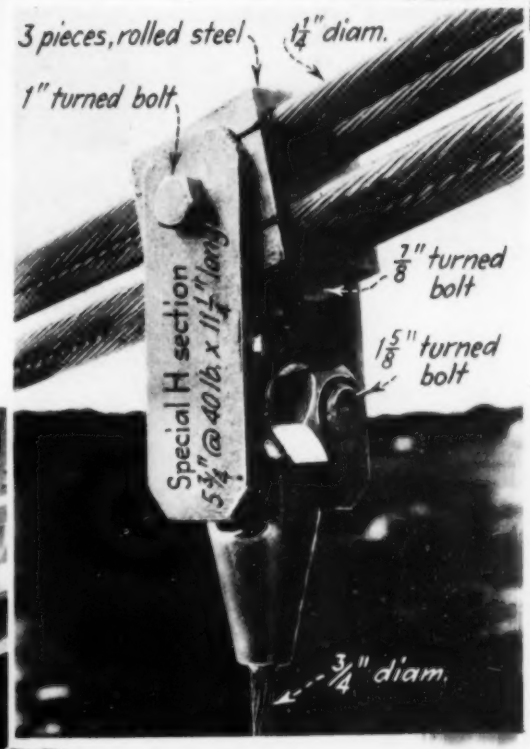
Time required for entire grinding and fluting operation on ⅝-round column drum having 15 flutes is 12 hr., one-fourth of time required by former methods. Operator travels on platform of moving grinder unit and controls all operations by electric push buttons on panel in front of him. Column drum is mounted on lathe, and movable grinder, which travels on former planer table, is adjusted transversely to proper position for any grinding operation.



INTERIOR FINISH OF STEEL is feature of new Canadian railway station at Hamilton, Ontario. Wall and column coverings, doors, counter grilles, and wainscot, products of Otis-Fensom Elevator Co., are held in place by concealed fastenings. Walls of No. 12 gage steel are finished in baked enamel of deep terra-cotta color. Column coverings of steel have bright aluminum enamel finish. At joints sunken head molding is used.

PAINT COATING is applied to steel reinforcement edge bars for concrete pavement in Rush County, Indiana, by simple equipment *(above)*, devised by W. J. Johnson Co. Two-inch pipe supported by wooden horses of 2x4s is slightly bent at center to hold a charge of paint. Bars are coated by drawing them through pipe and wiping off excess paint with rag held by workman.





SELF-ANCHORED SUSPENSION BRIDGE, built with total length of 450 ft. and main span of 225 ft. for Missouri Highway Department across Little Niangua River, has unique features. Four cables of 1¼-in. twisted wire prestressed strands *(at left)* are pin-connected to side-span girders by 9-in. eye-plates. Cable clamp *(above)* consists of three sections of rolled steel slab, bored to receive strands and bolted with ⅞-in. turned bolts. Web of H-section yoke is bored for connecting hanger sockets.

Step-by-Step

Building Bituminized Roads of "Semi-Macadam"

1 THE SUBGRADE, after being shaped to proper line and grade, is compacted by rolling with a 3- to 5-ton roller to a smooth surface parallel to the crown and profile of the finished surface.

"Semi-Macadam" Type of Construction

TWO types of bituminized cement mortar-bound pavement, designated as "semi-macadam" and "sandwich," were completed recently under joint state and county supervision on a 1-mi. length of Route 299 between Huron and Milan, Ohio, as a demonstration of approved methods and equipment for this class of low-cost road construction. As explained in an article in *Construction Methods* for March, 1933 (pp. 32-33), the cement for this type of road is an ordinary portland cement the grains of which, during the process of manufacture, are coated with a thin film of bitumen atomized at a temperature of at least 350 deg. F. and applied in amounts not exceeding 6 per cent, by weight, of the cement. The effects of the bitumen treatment, which induces sufficient elasticity during hydration to resist stresses promoted by temperature changes, are to retard the time of hardening and setting of the cement mortar, allowing it to remain workable long enough for thorough compaction by rolling, and also to minimize cracks in the finished surface. One of the main advantages claimed for roads built with bituminized cement, a product manufactured by the Medusa Portland Cement Co., under license from the T. R. C. (Temperature Resisting Cement) Corporation, is that they may be opened to traffic shortly after final rolling.

The accompanying photographs illustrate, in sequence, the main operations involved in both the "semi-macadam" and the "sandwich" types of construc-

2 BASE COURSE *(right)* of 1½ to 2½-in. stone is spread on prepared subgrade between metal side forms to uniform depth of 3 in. Even distribution of stone is obtained by use of spreader box on rear end of motor truck.

3 COMPACTION of base course to thickness of 2½ in. is accomplished with roller producing specified compression of from 200 to 300 lb. per inch of wheel tread width to "set" the stone.

4 SURFACE OF BASE COURSE shows voids in stone open to receive bituminized cement mortar from top course, when applied later.

Field Methods

Cement Mortar-Bound and "Sandwich" Types

tion. In both cases the pavement is 20 ft. wide, 4 in. thick, and has a parabolic crown with a rise of 1 in. at the center. The subgrade is formed by an old macadam road.

Semi-Macadam Type — The semi-macadam pavement is built in two courses placed between metal side forms 7 in. high. The base course consists of coarse aggregate (1½ to 2½ in. in size) compacted by rolling to a thickness of 2½ in. The top course is a mixture of 1 part bituminized cement, 2½ parts sand and 4.3 parts of aggregate (¼ to 1½ in. in size), the amount of bituminized cement mortar being sufficient to fill the interstices in both the top and bottom courses. Water in the mixture is limited to 5½ gal. per bag of cement. The top course material is mixed in a concrete mixer for at least 1 min., spread to a thickness of 2 in. and struck off either by hand or by machine to a height of ⅜ in. above the finished surface. The top course surface is then compacted by rolling, and is struck off to the specified 1½-in. thickness by a mechanical finishing machine. Transverse contraction joints are installed every 75 ft.

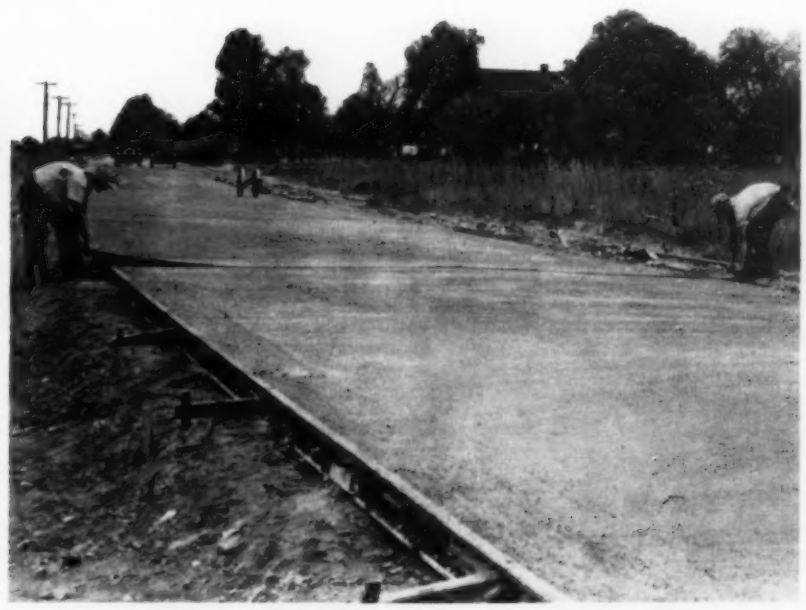
Sandwich Type—Construction of the "sandwich" type of pavement in Ohio followed the methods described in the March number of this journal previously referred to. Briefly, this type consists of two layers of loose stone aggregate (1½ to 2½ in. in size) between which is sandwiched a layer of bituminized cement mortar which is squeezed into the voids of both the lower and

5 TOP COURSE is a mixture of bituminized cement, sand and stone, containing enough excess mortar to fill voids in stone of base course. Top course material is mixed in concrete paving mixer, bucket of which has just discharged batch. Note finishing machine riding on metal side forms ready to strike off top course high enough to allow for subsequent compaction by rolling.

(On next page "sandwich" type of construction is illustrated)

6 ROLLING *(left)* interlocks the top and bottom courses, squeezing excess mortar into bottom course and bringing enough mortar to the surface for finishing. Any low spots developed during rolling are filled in with added mixed materials.

7 STRAIGHT-EDGE is applied to finished surface to check smoothness requirements of not more than ¼-in. deviation in 10-ft. length.



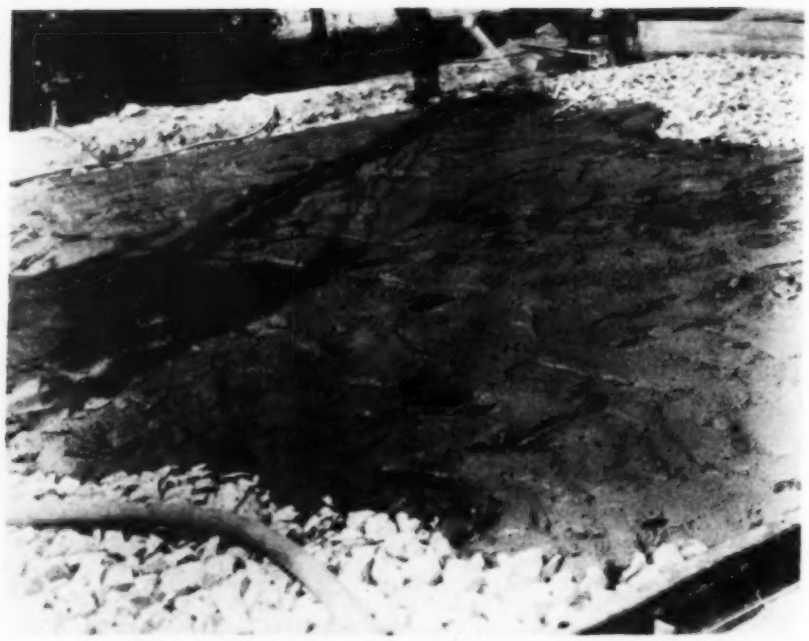
8 BELTING is final operation in finishing surface of "semi-macadam" type of mortar-bound pavement. Finishing machine instead of hand work, may be used on this operation.

Step-by-Step Field Methods

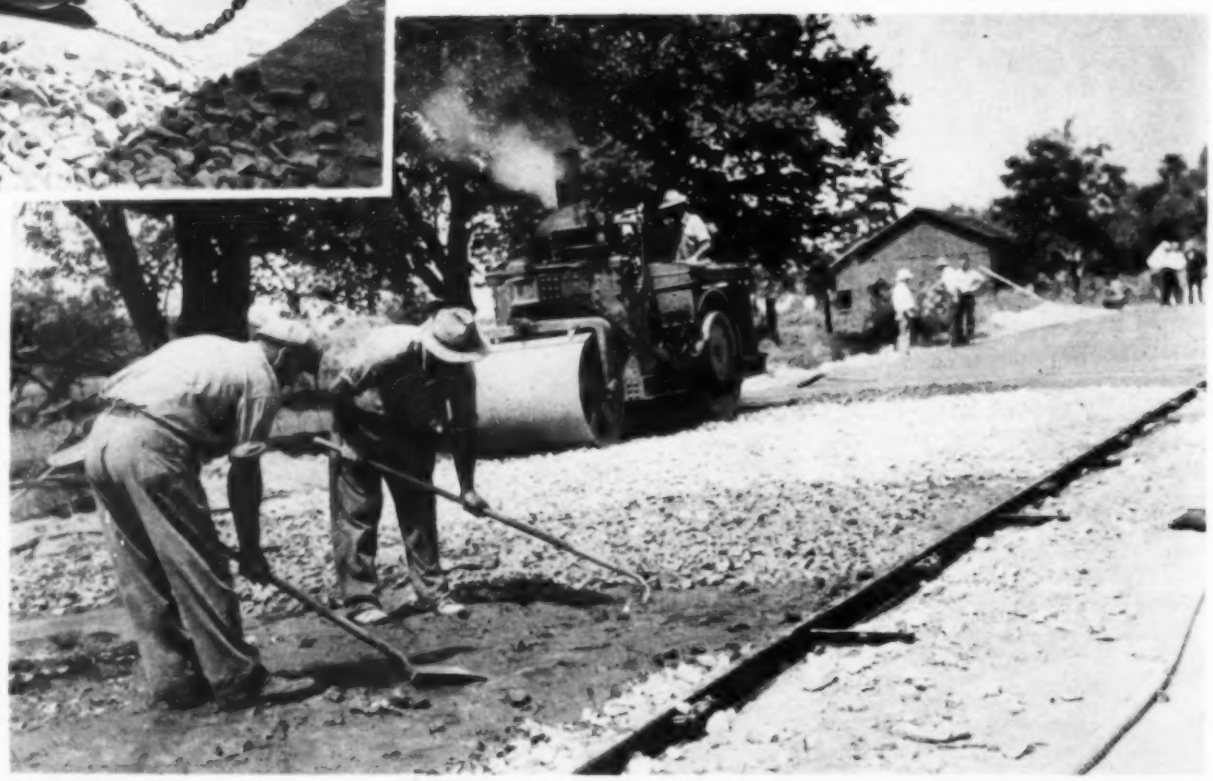
(Continued)

"Sandwich" Type of Construction

1 SPREADER distributes 1½- to 2½-in. size stone to depth (loose) of 2½ in. between metal forms for lower course, which is lightly rolled before "sandwich" layer of bituminized cement mortar is placed on it.



2 MORTAR LAYER sufficient to fill voids of both lower and upper stone layers is spread uniformly on lower course.



3 TOP COURSE *(right)* of 1½- to 2½-in. size stone is spread to depth (loose) of 2½ in. on top of sandwich layer of bituminized cement mortar and rolled to "refusal."

the upper stone layers by rolling with a 10-ton roller. The proportions for the bituminized cement mortar are 1 cu.ft. of T.R.C. (cement) to 2.75 cu.ft. of sand. The mixing time is specified as at least 5 min. The result desired at this stage is that the surface of the road shall consist of the exposed stone, with the mortar just below this surface.

After compaction by rolling, the surface is finished by a light seal coat of bituminized cement mortar broomed into place and covered with a light blotter coat of sand, lightly rolled.

The two types of road described were built by C. F. Bell & Sons, contractors, of Findlay, Ohio. The Ohio Highway Department was represented on this work by Ivan R. Ault, division engineer. For the County of Erie, H. F. Gerold is engineer; E. E. Hartung, assistant to the county engineer, had immediate supervision of the work.

4 ROLLING *(left)* forces mortar of sandwich layer into voids of stone in both bottom and top courses. As mortar is brought to surface it is distributed by brooming and surface is tested with straightedge. As a final operation a thin seal coat of mortar is spread and broomed or belted.

Helps to Successful Contracting

Fourteenth of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

By HARRY O. LOCHER
Contractor, New York

XIV—Bidding Methods

HERE is a subject, competitive bidding and methods of payment, about which there is a wide and emphatic difference of opinion. Much of it is based on good or bad fortune, or on certain unusual circumstances, rather than on logical analysis and equity to all parties in interest. A contractor who has just completed his first really successful job under the competitive bid system, or another contractor who has had a run of several successful jobs under this system, are stout defenders of the system. No cost-plus of fixed-fee jobs for them! They know their stuff and will gamble on themselves any time, on any thing. "I will stick to the competitive bid system until I lose my shirt," one of these contractors said. He did—and is now shirtless.

A nationally known contractor who has been through the mill, who worked hard, long and faithfully, who earned money here and lost it there, said, "If I could begin my career again, I would build it on some sort of sliding scale, fixed-fee-percentage method of payment. High class work, done as well and as economically as I could possibly do it, would be my constant aim. I would see to it that my business was conducted beyond reproach. I have been successful under the competitive bid system, but I had a great deal of good fortune."

Day Labor Evils—Another contractor, in condemning the straight cost-plus method, clinched his argument by saying, "Even the mules know when they are on a cost-plus job." From the swing of some cost-plus jobs it would seem that the mules did know it. Most day labor work is as bad—a shameful waste of money, a deadly destroyer of morale. Witness the day labor relief work being done about the country. Millions upon millions of dollars are being literally thrown into the gutters. Men work with not one iota of incentive to spur them. Politics governs the appointment of foremen and superintendents to whom it makes no difference whether they load one truck in a day, or fifty—when they should be loading 100. A pretty picture, wasting money and ruining men!

A certain good superintendent was showing a contractor friend over his job. Pointing to a crew of men a short distance away, who were obviously taking things mighty easy, he said, "Don't think that bunch is working for me. They are on that O & Z cost-plus job."

Cost-Plus—There is practically no sound reason for upholding the straight cost-plus method, except in some unusual situation in which the amount involved is not great. It is next to impossible to prevent both small and large abuses creeping in. On a certain large cost-plus foundation job men were worked from 1½ to 2½ shifts at a stretch, at time and a half and double time, to increase the cost of the work by increasing the size of the payroll. This in spite of the fact that from twenty to more than one hundred practically destitute men were at the job every morning seeking work. This was ruthlessness and exploitation of helpless, dejected men. It was a social crime.

On another job a large mill building was to be torn down to make room for another structure to be built at the completion of the work. The contractor was to be paid for this razing job by the straight cost-plus method. It proved a dumping ground for all the contractor's slack time. On rainy days or when certain men could not be kept profitably busy elsewhere, or when delays and breakdowns occurred, from one to several crews soldiered away on the cost-plus job, with no incentive whatsoever for efficiency or economy. This item became the butt of daily joking. Its influence spread to the regular unit price items. Morale and efficiency were interfered with and the contractor suffered.

It is not possible to perform contract work efficiently and economically without incentive or stimulus of some kind. Some natural human slackness cannot be kept out without it. This is true, in spite of lofty motives at the top. It is impossible to infuse such motives down through the entire organization. Many men will not do their best unless forced to do so. "Men will be men".

Sliding Scale Fixed Fee—The sliding scale, fixed-fee method of compensation, coupled with a time limit, can be made fair to all. Incentive and stimulus can then be used with telling and salutary effect. As the contractor falls away from the estimated cost of the work, the sliding scale begins to cut in on his fee. As he begins to exceed the date set for completion, the time penalty also begins to lower his fee. He is kept on edge. His organization is up on its toes; his men must make good or give way to those who can.

Unless the job is well managed, however, the contractor is put in the position of furnishing his experience, ability and all his resources—organization, equipment, funds—gratis, except, possibly, for a minimum fee for himself, a fee which he would not have considered at all at the beginning of the contract. Such a payment method, however, might save him from a calamitous loss, for reasons most probably quite beyond his control. As one outstanding contractor put it, "If I have learned my business through years of hard and bitter experience and conduct it honestly and efficiently and with pride of accomplishment, why should I risk losing my money in constructing something which will be a benefit to others? Why should I put myself in a position in which I might be penalized in offering the experience of my organization, the use of my own or hired capital and the use of my costly equipment? These are the things I have paid for dearly to resell at a just profit. Why should I have to pay for the privilege of using them for the public good? What logical reason is there for me using them as chips in a colossal game of chance? Some system!" he concluded disgustedly.

The fixed-fee method permits changing of plans without delay and bickering. It prevents friction and disagreements and expedites the performance of the work. The office forces of the principal and contractor working together further decreases the possibility of disagreement. All temptation on the part of anyone in the contractor's organization is removed. The structure is built as it was intended to be built—the principal is safe.

A Specific Example—Let us consider a hypothetical illustration of this system. Suppose that some city wanted to add to its water supply and that a part of the necessary construction was a 3-mile tunnel. Suppose some reputable firm of consulting engineers or estimators figured the cost of this tunnel at $4,000,000 and the time necessary for completion, 700 days. The work would be advertised for bids, showing the quantity of each item of work and its estimated cost. The contractor would be asked to bid a fixed fee for performing this estimated $4,000,000 tunnel contract in 700 days. The contract would stipulate that the contractor would forfeit one-half of 1 per cent of each $50,000 or part thereof that his costs exceeded the original estimate and that he would be penalized $100 per day for every day his completion time exceeded the estimated 700 days. It would be further stipulated that the combined penalties for exceeding cost and time estimates should not exceed 90 per cent of his bid fee.

Assume that the successful bidder had bid $280,000 as his fee. It would be possible for a contractor to lose $252,000 of his anticipated fee and to receive only $28,000 for his two years' supervision of the work. On the other hand, if the contractor did the work for $3,900,000, he would receive one-fourth of the $100,000 saved. For

Open for Discussion

● In this article on bidding methods Mr. Locher condemns both the straight cost-plus and the competitive unit price systems and advocates a sliding scale, fixed-fee method as the most equitable for all concerned.

● For years responsible contractors have been making honest efforts to establish construction on a sound business basis and to take it out of the category of a lottery. To accomplish this result Mr. Locher believes that radical changes are needed in current bidding practices. Everybody will not agree with his conclusions. The competitive unit price system has become firmly established and has many adherents. The mere fact that it is widely used, however, is no justification for its continuance. This is an era of rapid change and it is possible that present bidding methods, resulting in either feast or famine for the contractor, have become obsolete and should be superseded.

● In any event Mr. Locher's views should stimulate discussion among engineers and contractors. What has been *your* own experience under present bidding methods? What changes or improvements in bidding practice would *you* make to place construction on a sounder basis than it now occupies? Should the contractor assume all of the hazards or should some of them be carried by the owner or principal?

● The Editor of "Construction Methods" will be glad to have you express your opinion on any phase of this vital subject of bidding methods.

every day he cut off from the 700 days he would receive a bonus of $100 per day. But the combined savings in costs and time bonus would not exceed 40 per cent of his originally bid fee. Thus it will be seen that the most a contractor could get for this work would be $392,000, or a little less than 10 per cent. The least he could get for it would be $28,000, about seven-tenths of 1 per cent.

Professional Estimating—Here is the place to mention what might become a more widely practised profession—professional estimating. As mentioned in an earlier chapter, experienced estimators and experienced construction men working together will figure as near to true costs as is possible. Estimates made by them for work-letting bodies would be unbiased, uninfluenced by politics, and as sound a basis for letting work under such a system as would seem possible. Such estimates could be obtained from several firms and compared, and the final estimate of cost derived from their average.

"Good contractors come from the ranks. They have a long train of experience behind them. They do not attempt to launch out for themselves until they are qualified to do so. They begin with what they think they are qualified to handle and grow. As they grow they are careful of their reputations."

The virtue of the plan, of course, would depend upon the integrity of the estimators. Dependability! It seems as if everything always gets back to that. Honestly done, this would seem to be a safe and sane method of getting at the true costs of doing work. Of course, this is only the basis for such a plan. Much detail would have to be worked out. Fair overhead charges and equipment rental schedules would have to be considered.

Under the plan above suggested contractors could immediately begin work. Changes in plans could be made without working any undue hardship upon the contractor. Unforeseen difficulties which added to costs would be shared by both contractor and principal. The fact that such a system does not definitely show an owner in advance what his structure will cost is not just criticism of it. With an efficient, worthy contractor performing his work, he would be getting a fair deal whatever his structure cost. Worthy, efficient contractors should not bear all the owner's hazard. When a railroad shows a loss for the year the president is not asked to forego his salary, or is he asked to contribute from his own pocket towards the loss. Some might say the owner bears the entire hazard of his work under such a system. Why should the contractor bear it? Who benefits from the completed structure? Who should bear the hazard? In such a system only worthy contractors are being considered.

Good contractors are not ready made. Their skill and responsibility have been gained through long, hard experience. Their integrity has been established through years of honest dealing. Their pride of accomplishment is inherent in them. These intrinsic things are assets, not poker chips. Why cannot they trade them for fair compensation? Physicians, dentists, engineers and lawyers have to pass examinations to qualify them to practice their professions. Long years of experience and proper conduct in their business relations should be a qualification for fair treatment to constructors.

Competitive Bids—It must be admitted that the competitive bid system has good points. There is nothing like impelling necessity to bring out efficiency and economy to the fullest. For a contractor there is no greater incentive for efficient and economical performance than to know that if he slackens he will lose. Such incentive, too, will bring out all the construction ingenuity he can summon. But sometimes, with a contractor who does not put his reputation first, there is danger for the owner in the too low priced competitive contract.

"The low bidder is always penalized in having to do the job for less money than any other contractor thought it was worth. If his bid is too low and he is not a responsible, honest contractor, trouble of all sorts is in the offing."

Rather than suffer a loss, some contractors are tempted—and yield—to taking short cuts to save themselves. They will stop at nothing that they can get by with. They skimp in every way they can, from exploiting the workers to jeopardizing the quality of the structure. In many cases, if it were not for the honest, rigid inspection of the engineers, the extent to which this type of contractor would go to save himself from loss is hard to imagine. Should unscrupulous inspection and unscrupulous construction meet, what might befall the structure and the owner would appal contractors who are genuinely skillful and responsible.

Again, this skimping by unscrupulous contractors is premeditated. Bids are made with such an idea in mind, and honorable contractors are penalized even at the lettings—before a shovelful of dirt is turned. Some owners want shoddy work and connive with unscrupulous contractors, expecting to recoup in other directions and at the expense of others. In these instances the worthy contractor is penalized. Politics and collusion often place a worthy contractor at a disadvantage or eliminate him entirely.

No system has yet been devised which will always beat the ruthless and unscrupulous. The only way to beat them is to avoid dealing with them. It is a menacing fact, a fact which concerns too few, that the unscrupulous have so multiplied that they can carry on a lively trade among themselves at the expense of others, and this is as true in the construction industry as elsewhere.

Feast or Famine—The competitive bid system is either a feast or a famine. An unusual gain at one place is often offset by an unusual loss somewhere else. There is no logical reason for a contractor to get more for doing a certain job than he is entitled to, and less for another job than he is entitled to, with the same holding true for the principal. Except through unusual fortuity in rare cases, there can be no satisfactory equilibrium in such a method. It is safe to say that through a period of years few contractors are fortunate enough to earn more than a most reasonable return on the volume of work which they do.

In the competitive bid system, the owner or principal is too often between the upper and nether millstones of high and low prices. In the first case he may pay more than his work should cost, in the second he may get less than he pays for, depending into whose hands he falls. Where is the satisfaction in any such touch-and-go method?

The low bidder is always penalized in having to do the job for less money than any other contractor thought it was worth. If his bid is too low, which many times it is, and he is not a responsible, honest contractor, trouble of all sorts is in the offing—for the contractor himself, the engineers, the owner, the surety company, the banker, the equipment people, the suppliers of materials and about everyone else who has anything to do with the contract. Under the present method of awarding work to the lowest bidder—who is not always the lowest responsible bidder—there is only one course for the prudent contractor, the contractor who wants to remain in the business over a period of years and finish up with something to show for it, other than an accumulation of obsolete and non-salable equipment. This course is to allow nothing to influence him to bid foolishly or recklessly or to omit bidding on certain jobs which he knows he cannot get except at a price that would not make the job worth while, or at a price which might cause him a calamitous loss.

"In condemning the straight cost-plus method a contractor clinched his argument by saying: 'Even the mules know when they are on a cost-plus job.'"

The competitive unit price bid system has its good points, but it is like fire, useful if handled prudently and confined within safe limits but a destroyer which wrecks the good along with the bad when out of hand and running wild. Thoughtful reflection by those who can look backward for 30 years will provide grim evidence of what this system, running wild, has done. Where are the contractors of yesteryear? Where did they disappear? In that engulfing swamp of too low competitive prices! In the long run they could not beat the vicious game. The rules undid them, not themselves.

Contract Awards—There would seem to be more common sense in awarding a contract, under the competitive bid system, to the bidder nearest to the average of all bids rather than to the lowest bidder, or on an understood percentage of the average bid. As an example: Suppose that there were ten bids, beginning at $700,000 and increasing in amounts of $50,000 to $1,150,000. The average would be $925,000; 80 per cent of this average bid would be $740,000, or $40,000 more than the low bid. This would about compensate the low bidder for the "extra unusual ability" he thought he had over his competitors — which he didn't have. The foregoing is included only to adduce further thought on the question.

Of course, there are times when some very thoughtful, shrewd, far-seeing contractor may take advantage of something entirely overlooked by other bidders, or he may stumble on it. In such cases, if he is a worthy contractor, both he and the owner profit. But such instances are too rare to form the basis for general conclusions.

A preeminent contractor, on hearing of disaster to a friend, said, "It is nothing less than a tragedy for a contractor to work the greater part of his life, leaving every place he worked in better than he found it, to wind up broke and hopelessly in debt, as the result of an unfortunate contract." Too many things that contractors can not possibly judge or foresee enter into a construction job to increase or decrease costs—weather conditions, flood hazards, subsurface conditions, the rise or fall in the cost of labor and materials, the time element, collapse of structures (as has occurred in some hydraulic fill dams), changes in plans, which often increase costs not satisfactorily paid for, strikes, improvement in equipment and methods, and who can say what else.

Another contractor said, "When I take a competitive price job, it is because I can get it on no other basis. And don't forget that I add a plenty for the hazard I take. If nothing unusual occurs I am that much ahead, to help me out somewhere else—and the prin-

cipal has paid more for his job than he should have paid."

Why Take Chances?—It must be admitted that what these contractors said is largely true, and that many other outstanding contractors are in agreement with it. What just, logical reason is there for an honest, efficient contractor taking the full and often ruinous risks that the competitive bid system forces him to take? No other reason, it seems, than tradition. We have always done it, just as we did other monstrous things, until grim necessity forced us to abandon them lest we perish.

The construction industry numbers many of the most public spirited, high-minded men of the nation. But in their good judgment and inherent common sense they hesitate to undertake contracts, especially during such a time and by customary methods, which might utterly ruin them, unless they include enough for the risk involved. They realize that this makes their bids appear little less than ridiculous, but who can blame them for thus protecting themselves? Shall a momentary folly set them back a lifetime?

It takes contractors of real character, when they see a loss staring them in the face, to put the 100 per cent quality into their work that they agreed to and signed to put there. But there are such contractors, never doubt it! And owners are on safe ground in dealing with them on any basis—as long as they last! Under the faulty, competitive system, a good contractor wins here and loses yonder, using the same skill, integrity and responsibility in both places. The competitive bid system offers little appreciation and no reward for pride of accomplishment, or for agreements loyally fulfilled in spite of loss.

"The competitive bid system is either a feast or a famine. An unusual gain at one place is often offset by an unusual loss somewhere else."

Most of the competitive price adherents are proud of their craft, and justly so. They have confidence in themselves and in what they can do. Many of them are willing to take chances to gain unusually. But should the payment method of an entire industry be based on the views of the gamblers in the group? Many of these gamblers get along well until they hit an uncharted snag on their course. Some others luckily miss all snags and come into the final harbor safely. Among these fortunate few are the real defenders of the competitive price system, but a calamitous loss at the end would have converted them. Good luck is too often confused with good judgment or unusual ability.

Defense for Unit Prices—The strongest defense for the unit price bid system is that all contractors are not equally experienced or able, and that an owner should not be made to pay for experience and ability gained partly at his expense. Would it not be fair to reply that when a contractor has gained experience and established his reputation he should be placed in a different category and compensated on a basis that would free him from undue hazards over which he has no control? If he has survived up to such a time, is he not worthy of some unusual recognition? Has he not acquired something of great and satisfactory value to owners? Even though he has acquired these qualifications, he runs the risk of being wiped out every time he takes a unit price contract.

But what about contractors before they reach this point, you ask? Good contractors come from the ranks. They have a long train of experience behind them. They do not attempt to launch out for themselves until they are qualified to do so. They begin with what they think they are qualified to handle, and grow. As they grow they are careful about their reputation. At first they may be fully qualified to handle a $100,000 contract, but totally unqualified or able to handle a $1,000,000 job. A good contractor will not attempt to handle more than he feels he is qualified or able to handle. There is not the risk in small jobs that there is in large ones. While learning his business on a small job the contractor is not subjected to too great hazards. After he has learned his business and taken his losses and gains, he should be able to sell his experience and reputation without undue risk.

"When I take a competitive price job it is because I can get it on no other basis. And don't forget that I add plenty for the hazard I take."

Contracts are getting ever larger, with an ever-increasing risk and hazard in performing them. Contractors who have worthily gained experience and ability to handle such work, and who have built a reputation for business honor, should get the recognition they deserve by being freed from undue hazard in the performance of work for the public good.

Guessing at Prices—Few if any, contractors, even among the best of them, can accurately figure anywhere near what it will actually cost to do certain kinds of work. Witness the absurd and amazing difference in prices bid on certain contracts. They call it bidding. It is nothing but guessing. It is evolution of prices a great deal of the time. Each one taking a flyer and trusting to luck and the Lord that he will outguess all the others—and then lying awake at night until the job is completed, guessing how he will come out.

What more evidence is needed to show the absence of consensus of judgment as to what items really cost, as to how much time is required to perform certain work, and as to how much chance and guess really enter into figuring construction costs? With the uncertain price situation which now exists, where is the prudent contractor who would dare sign a competitive bid contract, unless he fully protected himself by including in his bid a tremendous margin of safety for the uncertainties and hazard involved? On some public work recently advertised in Seattle, no bids of any kind were received by the city. No contractor wanted to take such a chance under present conditions, at any price.

"Most of the competitive price adherents are proud of their craft, and justly so. They have confidence in themselves and in what they do. Many of them are willing to take chances to gain unusually. But should the payment method of an entire industry be based on the views of the gambler group?"

Competition Keen—Competition is getting ever keener, with opportunity for profit ever dwindling. Many are contracting who are not contractors. They are tyros who jump in, often backed and aided by political or other interests, to grab a profit from some job, often regardless of how it is managed.

Present-day methods of competition in the contracting business are just as ruinous as are competitive methods in most other businesses, and the satisfactory working out of some cases is a tenuous basis upon which to commend such a method for paying for construction work. Some rational, equitable payment system should be worked out, predicated on the work being done by skillful, responsible contractors, men with well seasoned experience and lofty principles. Any owner should be glad to pay such a contractor a fair fee for performing his work. He would be safe in paying such a fee on any agreed upon fixed-fee method.

Prequalification—Some good would undoubtedly come from a sensible, equitable method of prequalification. Bankers should get their prequalification information from those who are fully fair and qualified to give it. Equipment manufacturers and dealers should do likewise. Bonding companies should take more into account the man or men with whom they are dealing, rather than place most of their trust in financial statements, often tailor-made for certain occasions and uses. Many earnest, capable construction men, who live on their jobs and who put their hearts and souls into them, often cannot give a financial statement entirely meeting fixed and inflexible requirements. Nevertheless, they are better risks for bankers, equipment manufacturers, material dealers and bonding companies than are some of the absentee, psuedo-contractors who might have no difficulty in qualifying.

What has been done in this direction falls far short of being satisfactory. Many who are not worthy contractors can qualify, while many who are worthy, cannot, particularly in the early stages of their careers. It is a safe statement that some of the foremost contractors of America could not, at certain times in their career, have qualified. No contractor can prequalify to save himself from unexpected conditions or hazards quite beyond his control. The worthiest contractor is as likely to be the victim of these things as is the basest sort of man. He should not, if there is any merit in skill, integrity and responsibility, subscribe to a system that places him in a position where he is no more protected than are the unworthy and the unscrupulous.

Real whole-hearted organization is lamentably lacking among constructors. Good contractors and those not good, parade under the same banner. Luck has much to do with dividing them into losers or winners. The bid system is the heart and core of the situation. Until this is satisfactorily solved for contractors, owners and principals and until there is genuine cooperation and cohesiveness in contractor's associations, such associations are only treading water and making no headway toward any shore.

Conclusions—The writer's convictions are:

That the straight cost-plus system, except in small and unavoidable situations, has no merit.

That the sliding-scale-fixed-fee method, as briefly described in this chapter, is worthy of study and practice.

That the competitive bid system as we now have it is little less than a poker game.

That some system based on awarding contracts to the bidder nearest the average, or a certain percentage of the bid nearest the average, is also worthy of study and practice.

As stated at the outset, no feature of the business has been the subject of more controversy than has the bidding system. It has been mulled over for years. Little or no progress has been made toward a satisfactory solution. It is the writer's hope that what has been set down here will, in some way, contribute toward the ultimate satisfactory solving of the most vital problem in America's second largest industry.

NEXT MONTH: The fifteenth article in Mr. Locher's series on "Helps to Successful Contracting" will discuss "Moving to Yard or New Job".

Present and Accounted For —

A Page of Personalities

ARMY'S NEW CHIEF OF ENGINEERS. Col. Edward M. Markham, Corps of Engineers, U.S. Army, has been promoted to be Chief of Engineers, with rank of Major General, succeeding Major-General Lytle Brown, whose 4-year term of office expired last month. General Markham's former post was that of division engineer, Great Lakes Division, with headquarters at Cleveland.

Underwood & Underwood Photo

NORRIS DAM CONSTRUCTOR. Charles H. Locher, veteran contractor, has been appointed as the Tennessee Valley Authority's construction consultant on the Norris dam in Tennessee, on which preliminary work has started. A native of Virginia, Mr. Locher began his long and varied construction career on railroad work in the Southeast and later directed construction on such well known projects as the Chicago Drainage Canal, Wachusett dam and Weston aqueduct for Boston's water supply, St. Mary's River channel improvement below the Soo, Shoshone dam in Wyoming, New York State Barge Canal, New York City's Catskill aqueduct and Eighth Ave. subway. Beginning in 1917, he made a notable record as construction manager for the huge flood control project of the Miami Conservancy District, under Arthur E. Morgan, now chairman of the Tennessee Valley Authority.

PUBLIC WORKS BOARD HEAD. *(Below)* Major Carey H. Brown has been named chairman of the Technical Board of Review of twelve engineer members recently created by Administrator Harold L. Ickes as part of the organization of the Federal Emergency Public Works Administration.

Harris-Ewing Photo

JOHN D. WALDROP, state highway engineer of North Carolina.

W. W. ZASS, chief engineer of the Arkansas State Highway Dept.

LACEY V. MURROW *(below)*, director of the Washington State Highway Department

WILLIAM G. SLOAN, state highway engineer of New Jersey.

Four New State Highway Engineers

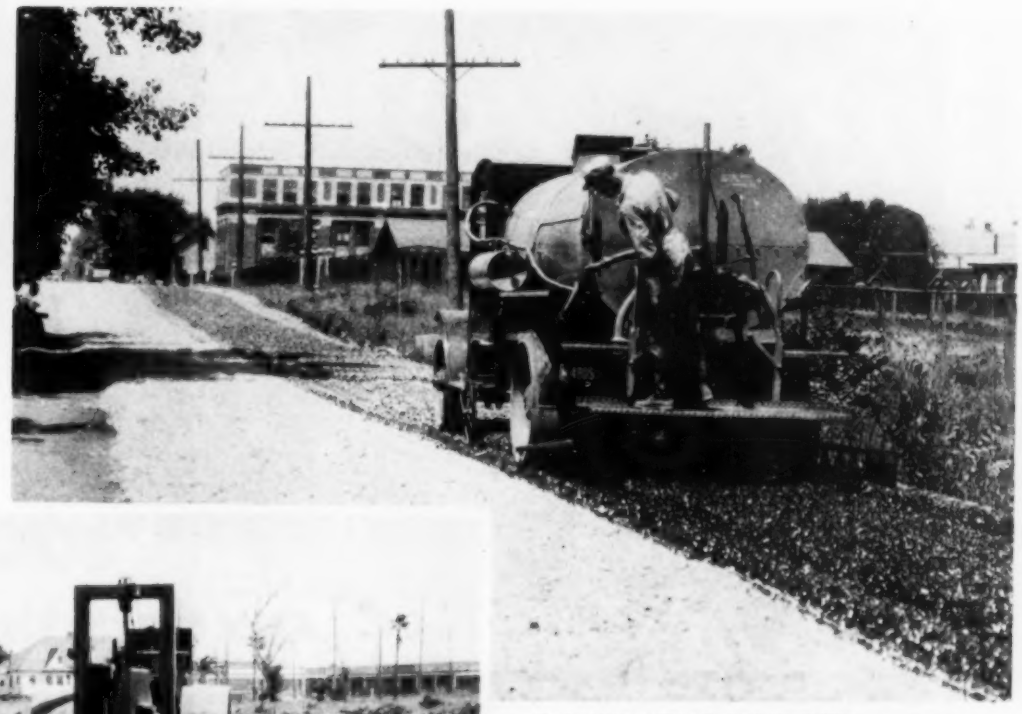
NEW EQUIPMENT *on the Job*

If You Want Further Information—

Within the space limits of this page it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.

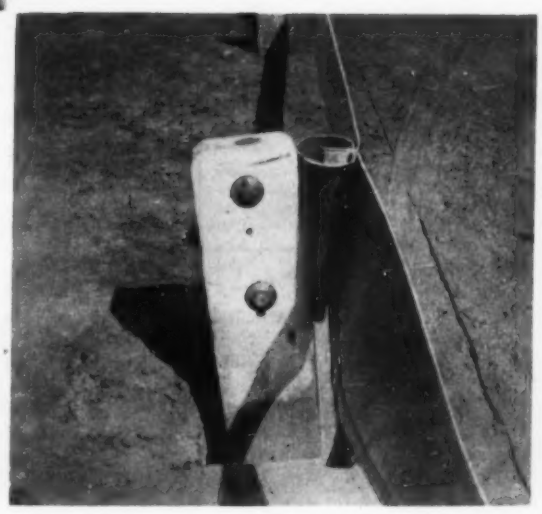
HIGH RESISTANCE TO WATER ABSORPTION and to fire is feature of new Goodyear-Graybar electric conduit made of cotton fibres bonded into homogeneous mass with special compounds and molded into uniformly round tubes with diameters true enough to prevent trouble with unevenness of joints during installation. Inside surface smooth and glossy, providing ideal cable raceway and reducing cable pulling strains. Having no surface oxidation, cable does not deteriorate to any degree and is always clean to handle. Made in lengths 5 to 8 ft. with inside diameters 1 to 6 in.—Goodyear Tire & Rubber Co., Akron, Ohio.



FOR MOUNTING ON TRUCKS, tractors or semi-trailers, bituminous distributor made in unit capacities of 400, 500, 600, 800, 1,000, 1,200 and 1,500 gal., will handle material of any character and apply it uniformly over any specified width in any desired quantity per square yard. Material in tank may be heated rapidly and safely to any workable temperature. Tank loaded by gravity or suction. Operating parts may be quickly and thoroughly cleaned after each application so material will not congeal as it cools.—Austin-Western Road Machinery Co., 400 N. Michigan Blvd., Chicago, Ill.

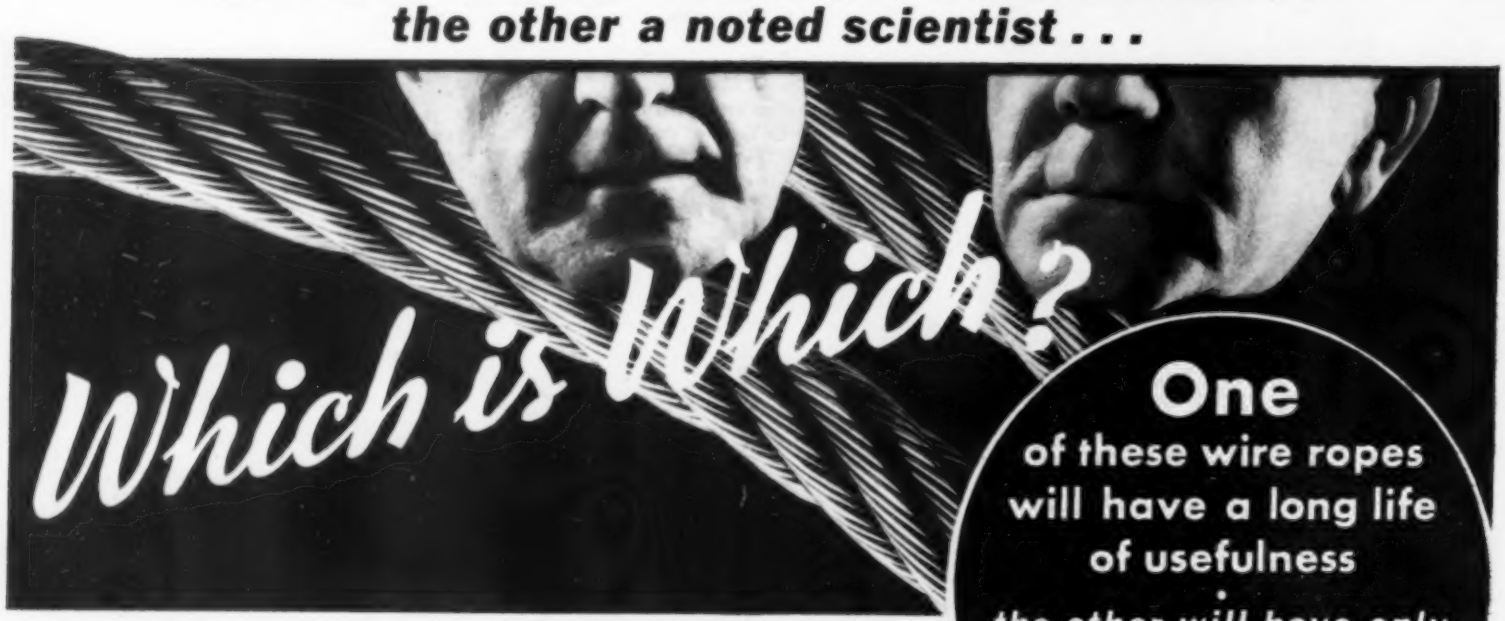
PIPE-LINE PLOW, designed to facilitate laying of oil and gas pipe lines, consists of two plowshares, an elevating moldboard, and a side wing or blade for disposing of earth. Mounted on wheel frame in such manner that depth of furrow can be regulated by cable from power controlled unit mounted on tractor which draws plow. Will dig 30-in. trench in three cuts, depositing earth about 6 ft. to right of center line in easy position for backfilling with bulldozer or angle-dozer or by hand. Position of sidewing is variable, and wing can be controlled independent of plow-shares. Plow leaves sidewalls straight and unbroken and is readily handled by 75-hp. tractor in high gear. —R. G. LeTourneau, Inc., Stockton, Calif.

TO INSURE MAXIMUM ROPE STRENGTH with the least amount of abuse, "No Pinch" wedge sockets are made to control pressure, to eliminate pinch on live side of rope, any excess pressure being transferred to dead side where tension is less and abuse less effective. This result is accomplished by the use of unsymmetrical wedges, preventing tilting, and by machining wedge sockets to protect rope wires where stresses are greatest. Available in sizes ranging from ⅜ to 2⅜ in.—John A. Roebling's Sons Co., Trenton, N. J.



GUARD RAIL *(right)*, of all-steel construction, designed to withstand severe shock by absorbing initial blow of vehicle and then deflecting it to position parallel to rail so that momentum may be checked easily. Rail consists of 12-in. wide plates with reinforced end connections fitting either rigid brackets adaptable to steel uprights on bridges or viaducts or cushion brackets for general guard rail use. Photo shows rail after test with 3,700-lb. Hudson sedan. Only damage to rail is slightly deformed bracket with no damage to car.—Truscon Steel Co., 6100 Truscon St., Cleveland, Ohio.

One of these men is a notorious criminal . . .
the other a noted scientist . . .



One
of these wire ropes will have a long life of usefulness
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the other will have only a comparatively short life under identical working conditions

Ordinary wire rope *looks* like Preformed when new, but *Performance* reveals the difference!

● The size of the human head does not indicate the degree of intelligence within. Neither does the appearance of new wire rope reveal the character of the service it will render . . . reasons why it is almost impossible to choose the correct illustration above. But there is a vast difference *in performance* between non-preformed wire rope and LAY-SET Preformed Wire Rope. In fact, much longer life is the actual comparative service record of LAY-SET on the same jobs under identical conditions. Change NOW to LAY-SET Preformed Wire Rope. Begin today to make this saving.

12 Good Reasons Why

In the manufacture of non-preformed wire rope, wires and strands are *forced* into position—held there under *stress* throughout the life of the rope. This *internal stress* will be responsible for the short life of the non-preformed rope shown above. In the manufacture of LAY-SET Preformed Wire Rope, wires and strands are preformed to take the exact helical shape of the rope. Entire rope strength is utilized to "carry the load." Thus, by eliminating internal stress, the preformed wire rope (above) will be given a long life of usefulness. Preforming gives perfect strand balance. There is less slippage. It resists kinking. Can be cut without seizing. Easier to handle and splice. Made in all standard sizes and lays. LAY-SET will cut your wire rope costs NOW.

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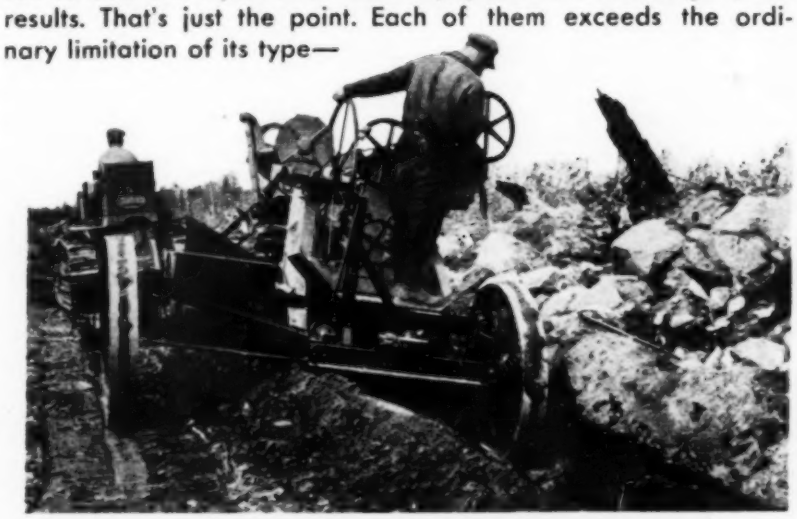

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THE AUSTIN BLADE GRADER—not to be spared when "unreasonable" obstructions are to be cleared. When a root or boulder blocks the way, don't shut your eyes and begin thinking of the cost of a new blade or a new grader. Watch: A straight-line pull delivers full power to the blade with minimum strain and full effectiveness. You'll get a kick out of seeing this Grader GO THROUGH!

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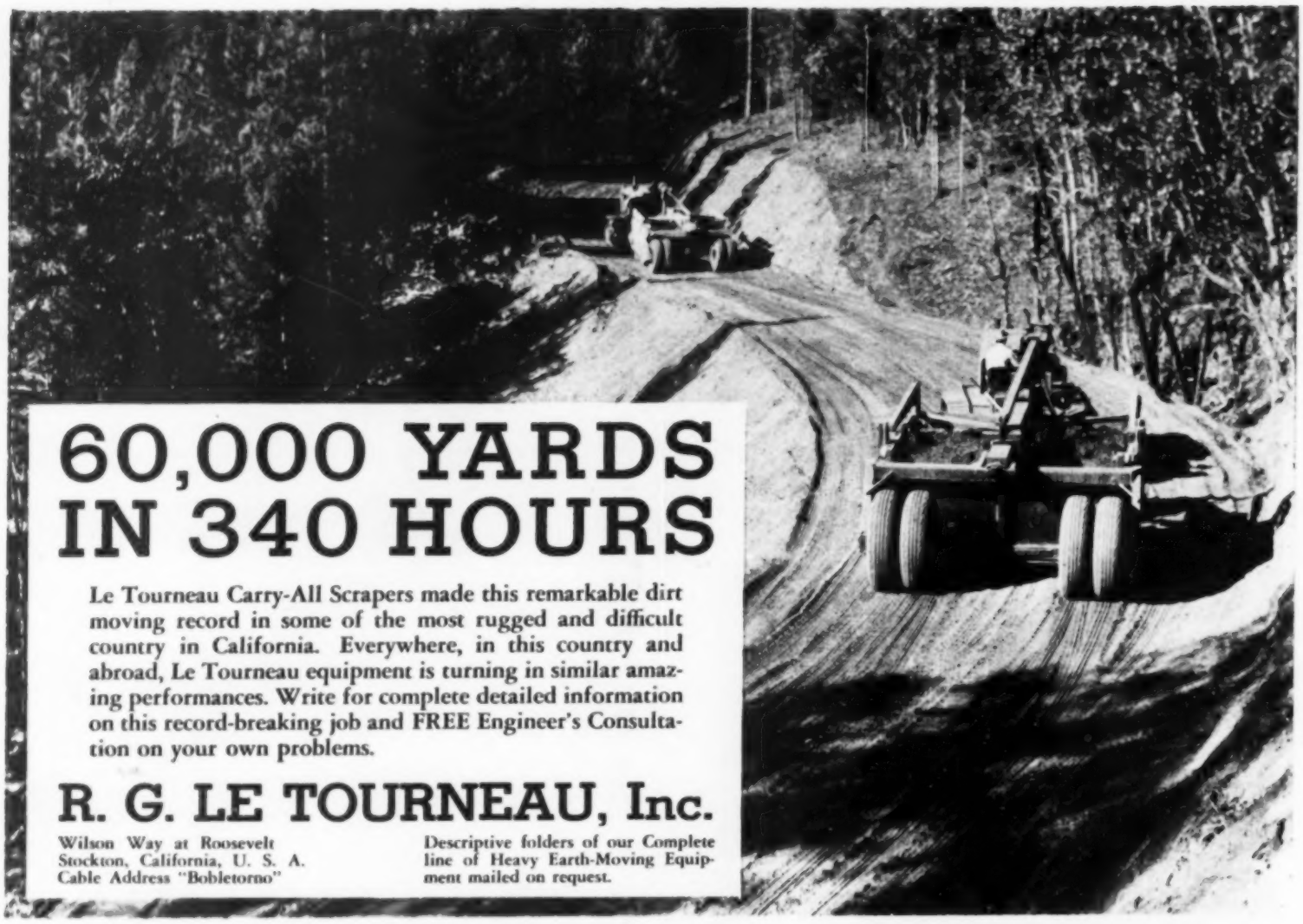

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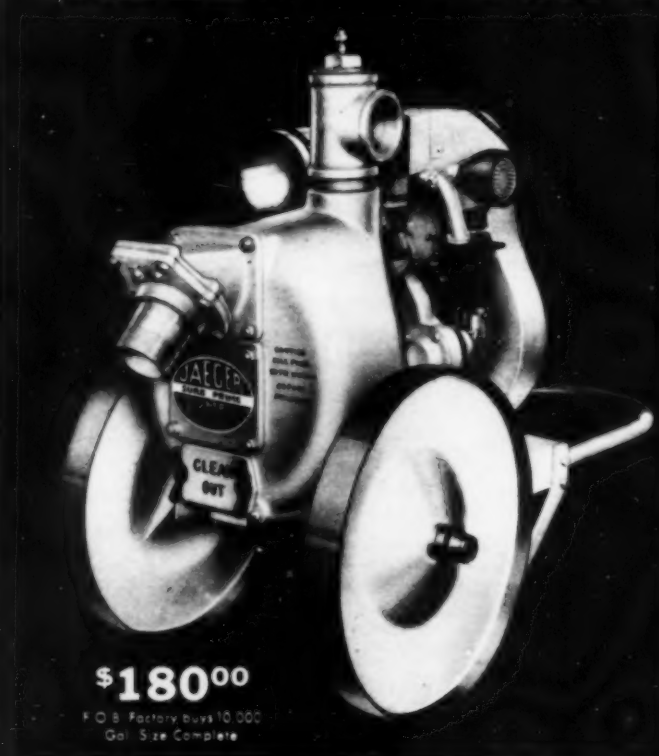

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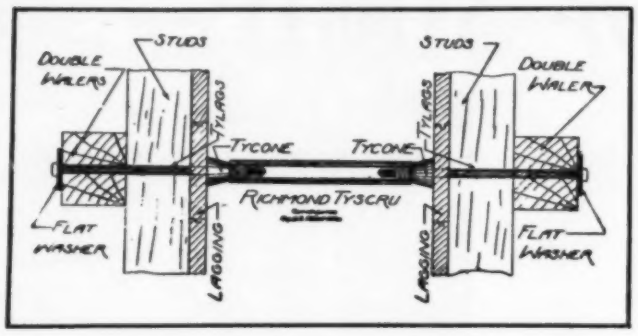

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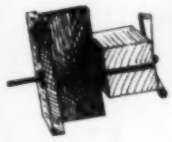

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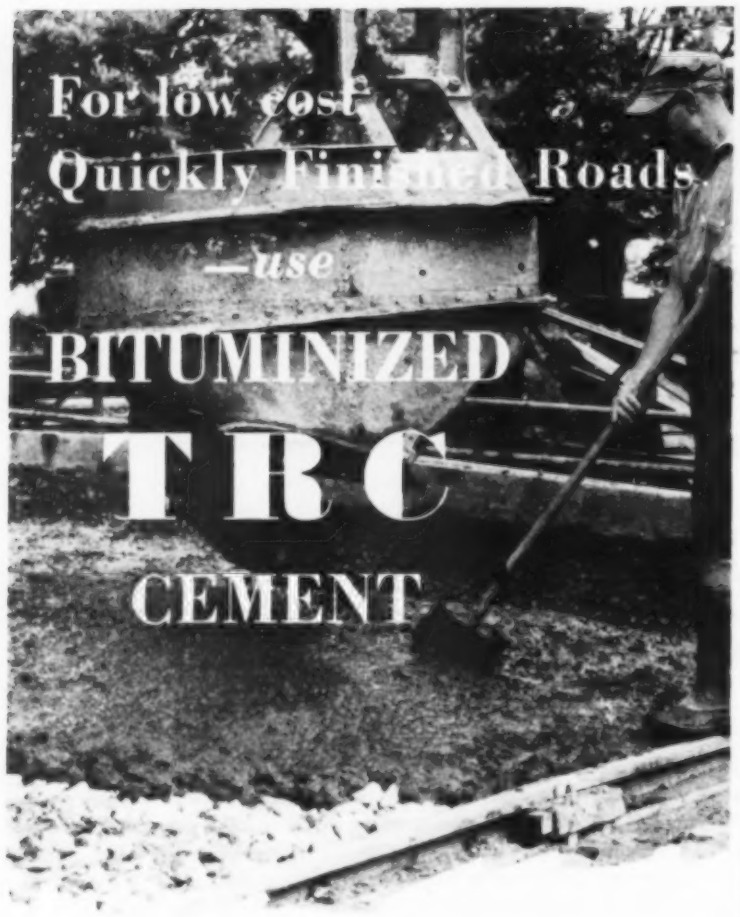

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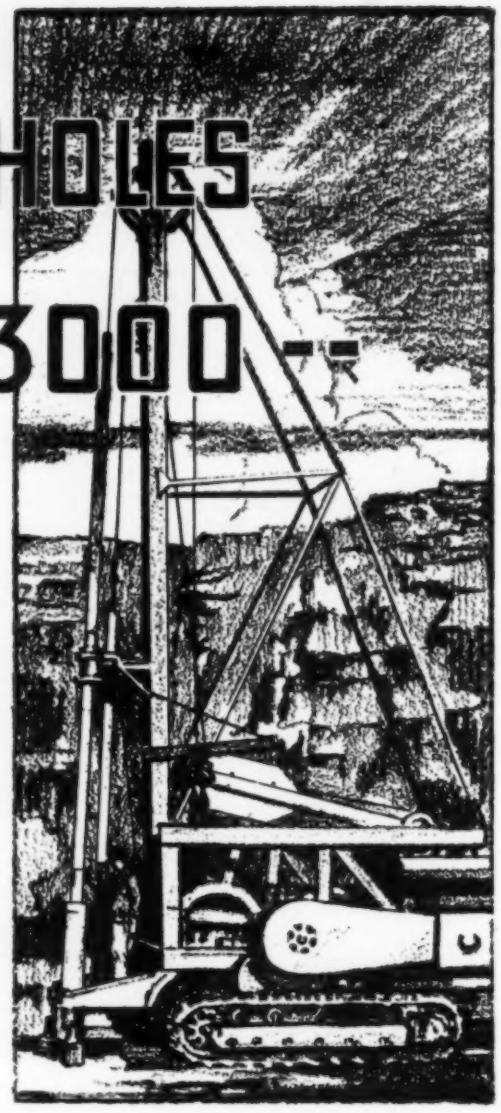

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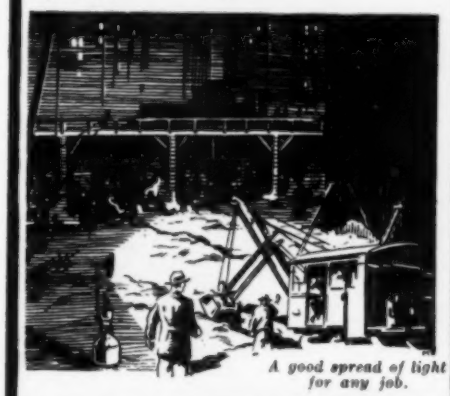

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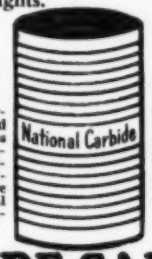

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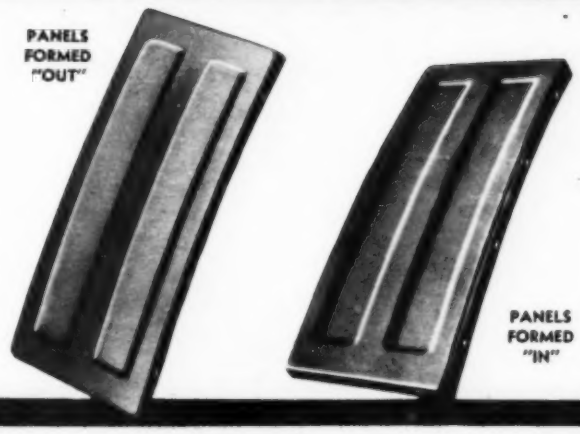

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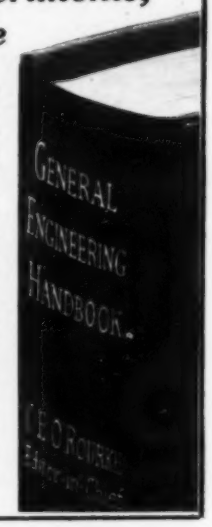

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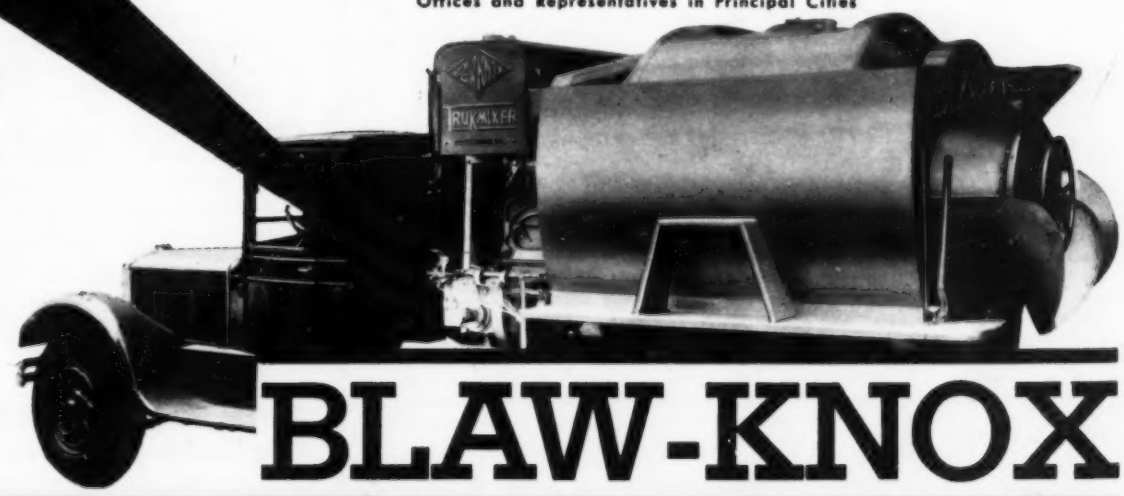

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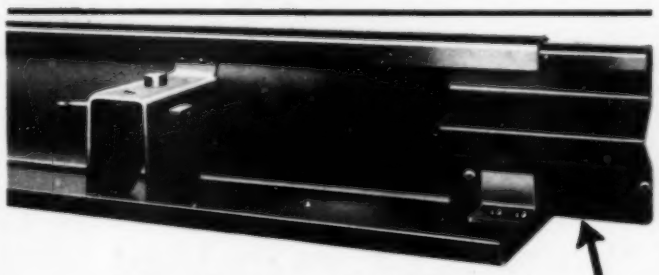

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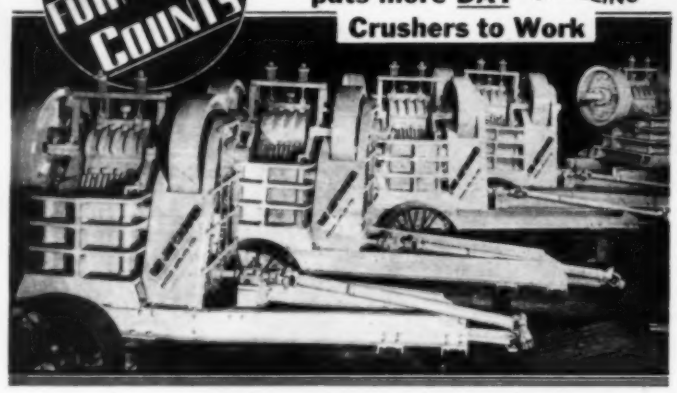

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Before me, a Notary Public in and for the State and county aforesaid, personally appeared B. R. Putnam, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Construction Methods, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42d Street, N. Y. C. Editor, Robert K. Tomlin, 330 West 42d Street, N. Y. C. Managing Editor, None. Business Manager, Willard Chevalier, 330 West 42d Street, N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) McGraw-Hill Publishing Company, Inc., 330 West 42d St., N. Y. C. Stockholders of which are: James H. McGraw, 330 West 42d St., N. Y. C. James H. McGraw, Jr., 330 West 42d St., N. Y. C. James H. McGraw, James H. McGraw, Jr., and Malcolm Muir, 330 West 42d St., N. Y. C., Trustees for: Harold W. McGraw, James H. McGraw, Jr., Donald C. McGraw, Curtis W. McGraw. Curtis W. McGraw, 330 West 42d St., N. Y. C. Donald C. McGraw, 330 West 42d St., N. Y. C. Anne Hugus Britton, 330 West 42d St., N. Y. C. Mason Britton, 330 West 42d St., N. Y. C. Edgar Kobak, 330 West 42d St., N. Y. C. Grace W. Mehren, 33 West Grand Ave., Chicago, Ill. J. Malcolm Muir and Guaranty Trust Co. of New York, Trustees for Lida Kelly Muir, 524 Fifth Ave., N. Y. C. F. S. Weatherby, 271 Clinton Road, Brookline, Mass. Midwood Corporation, Madison, N. J. Stockholders of which are: Edwin S. Wilsey, Madison, N. J. Elsa M. Wilsey, Madison, N. J.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the months preceding the date shown above is. (This information is required from daily publications only.)

B. R. PUTNAM, Secretary.

McGRAW-HILL PUBLISHING COMPANY, INC.
Sworn to and subscribed before me this 29th day of September, 1933.
(Seal) H. E. BEIRNE.
Notary Public, Nassau County N. Y. Co. Clk's No. 1516, Reg. No. 4-B-950.
(My commission expires March 30, 1934)

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Used Equipment
on preceding page.

EARN $2 AN HOUR DURING SPARE TIME

We need a man in every community, full or part time, as our local representative. By recommending and calling to the attention of business men, professional men, or workers, our business and technical books, which will help increase their business or their earnings materially, you can increase your own income each week substantially. All who see our lists, whether in shop or office find not one but many books they are eager to own. They find the ready reference knowledge that gives them quick and valuable assistance in their daily work. You can make $10 to $15 each week EXTRA, showing our lists to your associates or acquaintances during spare time. No experience required. Complete equipment, Free.

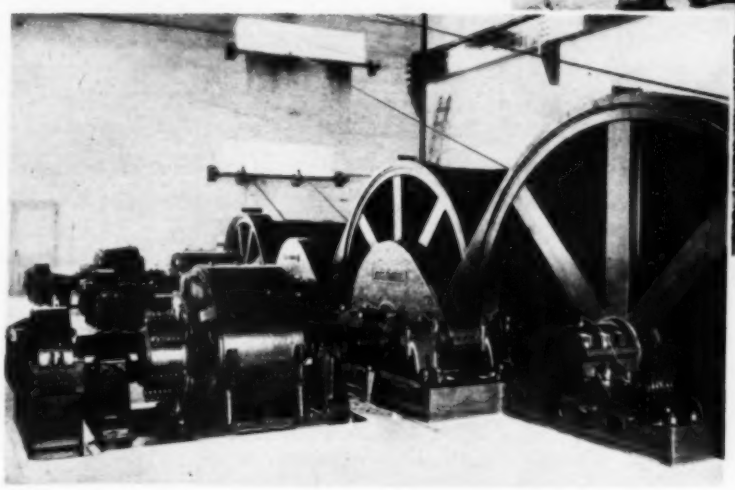
Write Tom Crawford, Dept. C.M.

McGRAW-HILL BOOK CO., 330 West 42d Street, New York City

World's Largest Cableway

MOTORIZED BY GENERAL ELECTRIC

USED FOR CONSTRUCTING AND SERVICING BOULDER DAM



Above—150-*ton Lidgerwood cableway equipped with G-E motors and safe, sure, semiautomatic G-E control*

Left—*Interior of hoist house, showing G-E motors with G-E magnetically operated service brakes, and large hoisting drums equipped with G-E Thrustor-operated emergency brakes. The Thrustors used for this purpose are the largest ever built; they produce a smoothly applied torque of* 175,000 *pounds-feet on each of the* 13-*foot-diameter hoisting drums. Maximum safety under all conditions is thus assured*

ONE of the construction problems emphasizing the immensity of the Boulder Canyon project is that of handling and placing the extremely heavy equipment to be installed there — for example, the giant 30-foot-diameter penstock pipes, certain special sections of which will weigh as much as 185 tons.

To solve this problem, and to provide a permanent means of servicing the equipment at the dam after construction work is completed, the Government drew up specifications for the cableway shown above. Recently completed, it has a nominal rating of 150 tons — more than four times greater than the capacity of any other known cableway.

Despite the fact that no previous cableway had ever approached this one in magnitude, General Electric supplied the motors and control substantially from stock. Similarly, you'll find that General Electric stands ready to supply you with the *right* motor and the *right* control for any application, large or small. Information concerning G-E equipment for cableways, tramways, cranes, hoists, etc. may be obtained by addressing the nearest G-E office, or General Electric, Dept. 6-201, Schenectady, N. Y.

NRA MEMBER U.S. WE DO OUR PART

200-784

GENERAL ELECTRIC

The WEST POINT of the AIR

(above) One of the hangar aprons at Randolph Field, Texas, paved with TEXACO Asphaltic Concrete.

(right) Randolph Field, a modern military community, showing the landing field in the background.

(lower right) Close-up of the TEXACO Asphaltic Concrete construction at Randolph Field; note its non-skid character.

Photo by U. S. Army Air Corps.

Not since it built the Panama Canal has the United States Army constructed a project equal in size to Randolph Field near San Antonio, Texas. At this Field, known as the West Point of the Air, the Army has now concentrated the training of its "bird" men.

On the streets of this modern military community, approximately 150,000 square yards of TEXACO Asphaltic Concrete paving have been constructed by the Southwest Bitulithic Company. Non-skid, resilient and waterproof, this TEXACO surface provides an ideal street pavement. However, in addition to serving on the streets of Randolph Field, TEXACO Asphaltic Concrete also has been laid on the aprons in front of the airplane hangers.

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